IDU

Intervention Impact Model
Version 2.0, May 2000

A tool to estimate the impact of
HIV prevention activities focused on
injecting drug users

May 2000

UNAIDS and the
Health Economics and Financing Programme
Health Policy Unit
London School of Hygiene & Tropical Medicine

HIVTools
A cost-effectiveness
toolkit for policy makers

IDU

Injecting drug user Intervention Impact Model Version 2.0, May 2000

A tool to estimate the impact of HIV prevention activities focused on injecting drug users

Developed by Peter Vickerman and Charlotte Watts

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1. Introduction to model and project

1.1 Background

A collaborative research project between the UNAIDS and the Health Economics and Financing Project at London School of Hygiene and Tropical Medicine, has been working since 1994 to develop methodologies to determine the costs and likely impact of different HIV prevention strategies - the strengthening of blood transfusion services, condom social marketing projects, school education, the strengthening of sexually transmitted disease (STD) treatment services, and interventions working with injecting drug user populations.

'*HIVTools*: a cost-effectiveness toolkit for HIV prevention' is currently being developed. *HIVTools* consists of 1) a set of five simulation models that estimate the impact on HIV and STD transmission of different HIV prevention activities, and 2) guidelines for costing different HIV prevention activities. *HIVTools* aims to be a flexible and easy to use product, designed for policy makers, programme managers and AIDS Service Organisations working to address HIV and STD transmission. It can be used to estimate the impact, cost and cost-effectiveness of different HIV prevention strategies in different settings.

IDU 2.0 is one of five simulation models within *HIVTools*. *IDU 2.0* can be used, within a particular setting, to estimate the impact on HIV transmission of prevention activities focusing on the injecting drug users (IDU's). It can also be used to explore the likely impact of different policy options. The program simulates the transmission of HIV between injecting drug users, and the transmission of HIV and STDs between IDU's and their sexual partners, both in the presence and absence of an intervention. The extent to which an intervention may avert HIV infection is estimated using a range of context specific inputs. This includes epidemiological information describing the prevalence of HIV infection among the IDU's and their non-IDU sexual partners at the start of the intervention, and the probabilities of HIV and STD infection. Behavioural inputs are used to describe the patterns of needle sharing, sexual behaviour and condom use among the IDU's reached and not reached by the intervention. Demographic and intervention specific inputs are used to estimate the size of the total IDU population, the proportion of males and females in the IDU population, and the proportion of each reached by the intervention. These are then used to project the overall patterns of needle sharing, sexual behaviour and condom use among IDU's with and without the intervention.

From conception, the aim was that *IDU 2.0* would be a simple tool that could be used to provide applied, intervention specific insights of use to program managers and policy makers. For this reason, the model's structure has intentionally been kept as simple as possible, and geared towards using the routine forms of monitoring and evaluation data currently being collected by interventions working with injecting drug users. The model has a selected range of inputs, linked to the main factors thought to influence the impact of an intervention. Certain possibilities, where there was little behavioural and evaluation data, were either not

included, or modelled in a limited manner. As more information becomes available, it may be necessary to modify the program's structure to reflect changes in understanding.

It is hoped that *IDU 2.0* can be used to improve understanding of the impact of interventions focused on IDU's and their sexual partners, to identify some of the key features influencing their impact in different settings, and to inform policy.

1.2 Key features of *IDU 2.0*

- A dynamic mathematical model of the transmission dynamics of HIV infection among injecting drug users, and the sexual transmission of HIV and STIs, both among IDUs and their sexual partners. The model can be used to obtain:
  - Trends in HIV infection among IDU's with different levels of needle sharing
  - Trends in HIV and STI infection in the presence and absence of an intervention
  - Trends in HIV incidence in the presence and absence of an intervention
  - Short-term estimates of the number of HIV infections averted among injecting drug users and their non-IDU sexual partners.

- *IDU 2.0* aims to use the forms of behavioural, epidemiological and intervention process and outcome data that are commonly collected by interventions working with injecting drug users.

- *IDU 2.0* incorporates a range of intervention specific inputs, which enable the user to explore the short-term effects of different forms of intervention activity on the overall patterns of HIV and STD transmission among injecting drug, and the numbers of HIV infections averted over a specified time.

- *IDU* 2.0 is a self-contained piece of computer software, that aims to be user friendly to a broad range of individuals concerned about HIV transmission within injecting drug users.

Possible effects of IDU intervention in model

The model incorporates a range of ways in which an IDU intervention may alter patterns of HIV transmission among IDUs and their sexual partners, including:

- Reduce the rates of movement into the IDU population each year;

- Decrease the number of needle sharing incidents among IDU's;
- Reduce the average number of people sharing needles;
- Increase the level and/or consistency of cleaning used needles;
- Decrease the number of sexual partners of IDU's;
- Increase the consistency of condom use in IDU sexual partnerships;
- Increase the coverage of the intervention.

1.3 Development and distribution of *IDU 2.0*

The initial structure of the model developed is the result of a series of consultations with expert advisory committee consisting of staff from UNAIDS and WHO, and followed a review of the literature on HIV prevention activities working with injecting drug users. Simple flow charts were used to describe the model structure and underlying assumptions. These were used to enable a range of groups to guide the model's structure. The model and its underlying assumptions were field tested in Belarus in 1999. Informal discussions with key informants, and the findings from several epidemiological, behavioural and evaluation studies were used to assess the relevance, applicability, ease of use and validity of the model. Further field-testing will be required to assess the more general applicability of the model, and to refine its format to the needs of specific users.

Version 2.0 was finalised in May 2000, and can be obtained free of charge from UNAIDS. It is likely that further revisions to the model will be made once feedback on its use has been obtained. Anyone who would like to receive up-dated copies of the model should write to London School of Hygiene and Tropical Medicine giving their contact details, and describing how they plan to use the model. They will then be sent the latest version of the model and an accompanying manual. Copies of any reports or publications arising from use of the model should be sent to UNAIDS, and to Dr. C. Watts at the London School of Hygiene and Tropical medicine. Feedback on the model would be greatly appreciated, and will be used to guide the future development of the package.

1.4 Model Outline

The program simulates the transmission of HIV among IDUs, and the sexual transmission of HIV and a generic STI infection between injecting drug users and their sexual partners, both in the presence and absence of an intervention. The impact of the intervention is determined using context specific epidemiological data, estimates of the coverage of the project among the overall injecting drug user population in any one location, and measures of the impact of the intervention on reported levels of needle sharing, sexual activity and condom use.

Demographic, behavioural and intervention processes and outcome evaluation data are used to estimate:

1) The total size of the drug user populations in the city or location of interest
2) The numbers of drug users recently reached by the intervention
3) The impact of the intervention on
    - the overall distribution of needle sharing by drug users.
    - Levels of sexual activity among IDUs
    - Levels of bleach use when sharing syringes
    - Patterns of sexual mixing among IDU's and with non-IDU's
    - The consistency of condom use amongst IDU sexual partnerships
    - The movement of individuals into and out of the IDU population

Thus, for example, the overall distribution of needle sharing among the IDU population in the presence of the intervention is calculated using inputs describing:

- the size of the overall IDU population;
- the proportion of IDUs targeted by the intervention;
- the proportion of those targeted who have been recently reached by the intervention;
- information on the distribution of needle sharing among IDUs who have not been recently reached by the intervention;
- information on the distribution of needle use among IDUs who have been recently reached by the intervention.

Figure 1 outlines the structure of the HIV and STI transmission dynamics simulated by the model. The model simulates the patterns of HIV and STI transmission resulting from needle sharing and sexual contact between six groups of males, six groups of females, and their sexual partners. Males and females are divided into three categories - those that do not share needles, those that have a low degree of needle sharing and those that have a high level of needle sharing. These in turn are divided into those with no sexual partners, those with low numbers of sexual partners, and those with high numbers of sexual partners. Inputs describing patterns of

condom use are used to estimate the proportion of males and females with high a number of sexual partners who use condoms 'all of the time', 'half of the time' or who are 'not using' condoms. In each case the proportions in each sub-group is influenced by the baseline distribution of reported behaviour, the extent to which the intervention reaches the overall population, and the degree to which contact with the intervention results in changes in different risk behaviour.

For simplicity, it is assumed that the baseline IDU population remains fixed in size over the timeframe considered. IDU's may stop injecting either after a fixed duration of time, or due to HIV or IDU related morbidity (such as overdose or sepsis) and are replaced by new, HIV susceptible, IDUs. In contrast the IDU population that has been reached by the intervention may vary in size due to the intervention effecting the movement of individuals into the IDU population.

The model includes the possibility of HIV and/or STI transmission between IDUs and their non-IDU sexual partners. Because of the difficulties associated with collecting detailed demographic or behavioural data from the non-IDU sexual partners of IDU, the dynamics of HIV and STI infection among non-IDU sexual partners is modelled in a limited manner – by assuming that this population is fixed in size over the timeframe considered, with a specified initial prevalence of HIV and STD. Further revisions of the model may refine this aspect of the model.

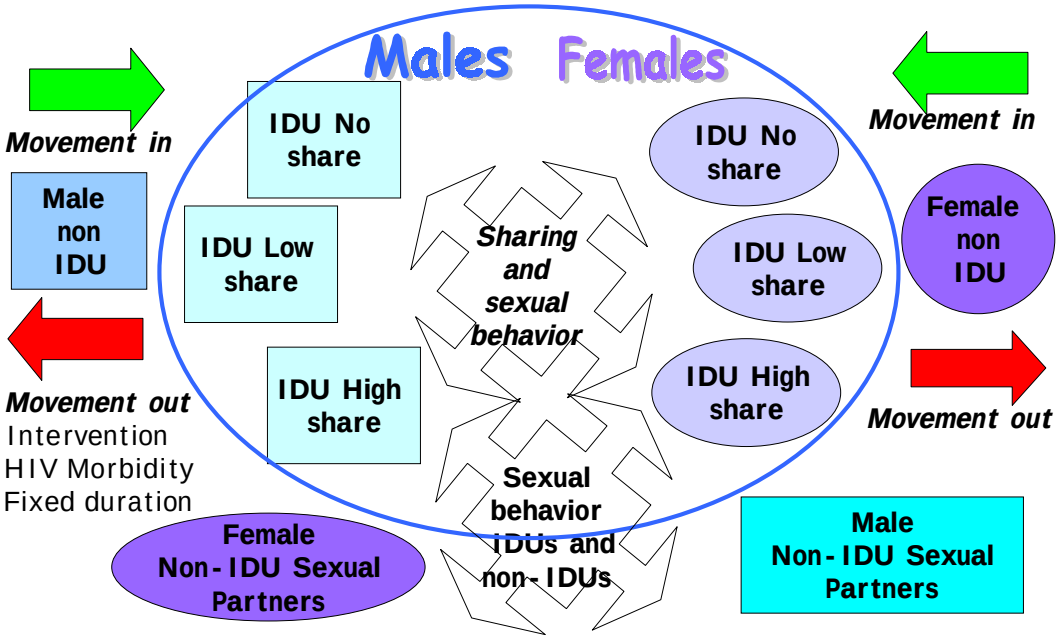
In the model, male and female IDU's are sub-divided into sub-groups according to their levels of needle sharing, levels of sexual activity (number of partners per year), and levels of condom use. Each sub-group is then assumed to be homogeneous, and to randomly select needle sharing and sexual partners according to specified rules of mixing defined using the model's input parameters.

Because the transmission of HIV infection is facilitated by the presence of an STD, the model simulates how, over time, both a 'generic' STD and HIV infection may spread among IDUs and their sexual partners both in the presence and absence of the intervention. As there is also an increased probability of HIV transmission during the initial high viraemia phase of HIV infection, at each point in time, HIV infected individuals are divided into those with early infections (in a high viraemia phase) and those with more long-term infections (in a low viraemia phase).

Figure 1

IDU transmission dynamics

IDUs and sexual partners



Section 3 describes in more detail the inputs required by the model. Details of the underlying mathematics are given in Vickerman and Watts (2000). A summary of the input values are given in Appendix 1.

2. Installing and running *IDU 2.0*

2.1 Installing and opening *IDU 2.0*

Version 2.0 of *IDU* is a stand-alone program designed for use on an IBM-compatible computer. The program can be run in a 32-bit Windows environment (95 or above). Copies of the program and manual can be obtained from UNAIDS.

All of the files needed to run this program are on the floppy disk (or cd-rom) included with this manual. To install *IDU 2.0*, you need to run the file SETUP.EXE, included on the floppy disk (or setup idu file on the cd –rom).

Installing and opening from Windows 95, 97 or 98*

Step 1. Close all running applications of *HIVTools* and insert the *IDU 2.0* disk in your floppy disk drive (or cd rom drive as appropriate).

Step 2. In Windows Program Manager, choose Run from the [START] menu

Step 3. Type 'a:\setup', where a: is the letter of your disk drive, (or type 'd:\setup idu' where d is the letter of your cd-rom drive) and press [Enter]. This will start the installation process.

Step 4. A dialog box [HIV Prevention Models Version 3.0 Setup] will appear on your screen. Use the mouse to select the [OK] button on the dialog box or press [Enter] to continue the installation process.

Step 5. Another dialog box [COLLECTING SETUP INFORMATION ....] will then appear on your screen. This gives details of the location and name of the directory in which the *IDU 2.0* program files will be copied, the name of the program group in which the *IDU 2.0* program icon will be placed, and the location of the installation files. By default, the installation process will create a directory on your C: drive called 'Models', to contain the program files; and will create a program group 'HIV Prevention Models', in which to place the *IDU 2.0* program. The location and name of the directory, and/or the group name, and/or the location of the installation files can be changed by entering a different drive, directory name and/or group name in the dialog box. Once you have made any desired changes, use the mouse to select the [NEXT>>] button on the dialog box or press [Enter] to continue.

*. Windows 3.1, Windows 95, Windows 97 and Windows 98 are registered trademarks of Microsoft Corporation.

Step 6. A warning dialog box will now be shown on the screen, warning that the installation process cannot be completed if other applications of *HIVTools* are running. If necessary, use the [Alt]-[Tab] keys to switch to any open applications of *HIVTools*, and then close them. Once all other applications are closed, select the [OK] button or press [Enter] to continue with the installation process.

Step 7. A dialog box will now be shown providing information on the progress made in installing *IDU 2.0*. At any point, you can select the [ABORT SETUP] or press [Esc] to terminate the installation process. Once installation is complete, a dialogue box [CONGRATULATIONS!] will appear on the screen, to inform you that the model has been successfully installed. Select the [OK] button or press [Enter] to exit the installation program.

To run the program, click the *IDU 2.0* model icon within the 'HIV Prevention Models' program group.

Note: IDU 2.0 cannot be installed and opened from DOS or Windows 3.1[1]

2.2 Running *IDU 2.0*

Once *IDU 2.0* has been opened, a screen containing the Main Menu will appear:

Selecting menu headings and menu items

Within a Windows environment, the mouse can be used to select menu headings and menu items, to enter data, and to select the format in which to view the results. In addition, the following keys can be used:

Arrow keys The Up-Down and Left-Right arrow keys can be used to move up and down and between menu selections.

ENTER key The [Enter] key can be used to select menu options and to signal completed input of data into fields.

TAB key The [Tab] Key can be used to move in the forward direction between entry fields within any of the menu selection screens. Using both the [Shift] and [Tab] keys together allows movement in the reverse direction between entry fields.

ESC key The [Esc] key can be used to return to a higher menu level.

ALT key The [Alt] key, in combination with one of the letters underlined in the list of menu options, can be used to view the menu options. The [Alt] key, in combination with one of the letters underlined in the list of menu selections, followed by the [Enter] key, can be used to select the option.

3. Menu headings

IDU 2.0 has five primary menu headings: File, Values, Results, View and Help. These are described in turn below.

3.1 FILE

Within [FILE], it is possible to open new parameter files, edit existing files, access the default values, and exit the program. [FILE] can be selected using either the mouse, or by pressing the [Alt] and F keys together. Options within [FILE] can then be selected by using the mouse; using the down arrow key to move the highlighted bar down to the option required and pressing [Enter], or by pressing the [Alt] and the appropriately lettered key together.

File¦Open – can be used to locate and open saved files of input parameters. All input files for *IDU 2.0* have the extension NAME.idu. When *IDU 2.0* is opened, by default it will open the default parameter file. Existing files can be selected either by using the mouse, or by using the [Tab], arrow and [Enter] keys to move between folders and files.

File¦Save – can, in the same manner, be used to save the current input parameters in the open parameter file. It is not possible to alter the input values assigned to the default data input file.

File¦Save as ... – can be used to save the current input parameters in a new parameter file, with the extension NAME.idu. This can be used to develop, for example, files of input values from a injecting drug user intervention being implemented in a particular setting.

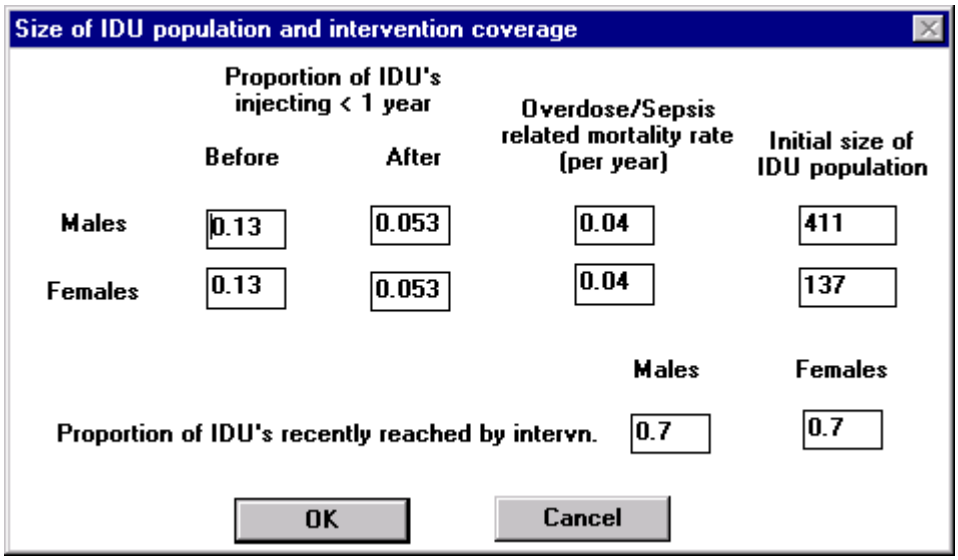
File¦Print - prints the current data output file.

File¦Exit - exits *IDU 2.0.*

3.2 VALUES

The [VALUES] menu is used to change the input parameters used in the program simulations. Five sets of inputs are required: computational; epidemiological; behavioural; intervention coverage and impact; and transmission. Within [VALUES], it is possible to modify the inputs used to estimate the impact of a particular intervention. [VALUES] can be selected using either the mouse, or by pressing the [Alt] and V keys together.

For illustration, the size of IDU population and intervention coverage screen within [VALUES] is shown below.



Options within [VALUES] can be selected using the mouse; or by using the down arrow key to move the highlighted bar down to the option required, and then pressing [Enter]. Once an option within [VALUES] has been selected, a list of inputs will be shown. The input values shown can be selected and altered either by using the mouse, or by using the [Tab] key or the [Tab] and [Shift] keys together to move between different entry fields. By clicking the OK button or pressing [Enter], the user can exit the option and return to the [VALUES] menu. The input values shown at this point will be used in any subsequent calculations. More details about the [VALUES] menu are given in *Section 4*.

3.3 RESULTS

The [RESULTS] menu has only one option - [CALCULATE]. [RESULTS] can be selected using either the mouse, or by pressing the [Alt] and 'R' keys together. [CALCULATE] can be selected either by using the mouse, or by first using the down arrow key to move the shaded bar to [CALCULATE], and then using the [Enter] key to select this option. The model will then use the current input parameter set to iteratively simulate over time patterns of STD and HIV transmission among drug users and their sexual partners, both in the presence and absence of the intervention.

3.4 VIEW

The outputs from a model simulation can be viewed in a number of ways. The projected trends in HIV and STD prevalence among different subgroups, with and without the intervention, can be viewed either in a data format or plotted on a graph. Estimates of the cumulative number of HIV infections averted by the intervention among IDU's and their non-IDU sexual partners can also be viewed, in a data format and/or on a graph. The menu options within [VIEW] are listed below:

View¦Data outputs - shows the main data outputs for each month in a table.

View¦Graphs - the model output can be viewed in five different graphical forms, (see *Section 5.2*).

View¦Infections averted - shows a summary bar-chart of the estimated number of HIV infections averted each year among drug users over the timeframe being considered.

View¦Summary sheet – gives a summary of the main inputs and model outputs.

View¦Flow charts –shows the flow charts outlining the conceptual framework and main inputs of the model.

3.5 HELP

The [ABOUT] option in the [HELP] menu gives a summary of the *IDU 2.0* model. A more detailed [HELP] function has not been developed.

4. Model inputs

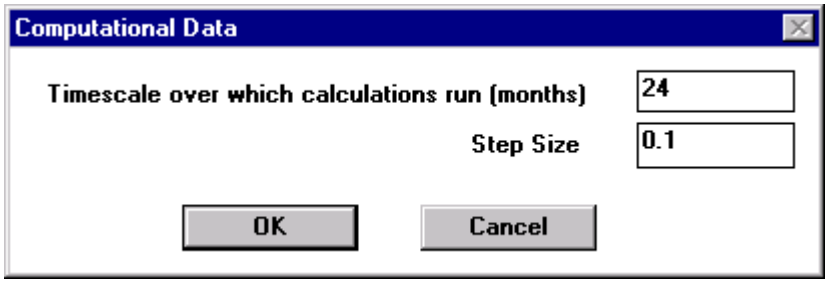
The model requires a range of input parameters, which are entered in the computational, epidemiological, transmission, size of IDU population and intervention coverage, fixed needle sharing behaviour, fixed sexual behaviour and intervention impact dialog boxes in the [VALUES] menu. The intervention impact dialogue boxes include the following: IDU sexual activity, IDU sexual partners, IDU needle sharing and condom use.

The [VALUE] menu can be used to change any of the input parameters used in the simulations. The mouse, arrow and return keys can be used to move between different input screens, and to change the model's inputs.

Where appropriate, limits on the possible range of different parameters have been specified in the model (such as proportions being between zero and one). Where a chosen number falls outside the permissible range, an error sign is displayed, and the user is given the option to input a different number. The model comes with a default set of pre-assigned behavioural, epidemiological and intervention specific inputs. Each time the program is opened, the set of input parameters revert to their default settings. Other sets of inputs can be saved in [FILE], under the header [SAVE] or [SAVE AS].

Each of the dialog boxes are described below. The default values used are shown in the dialog boxes.

4.1 **Computational Data** - change computational inputs

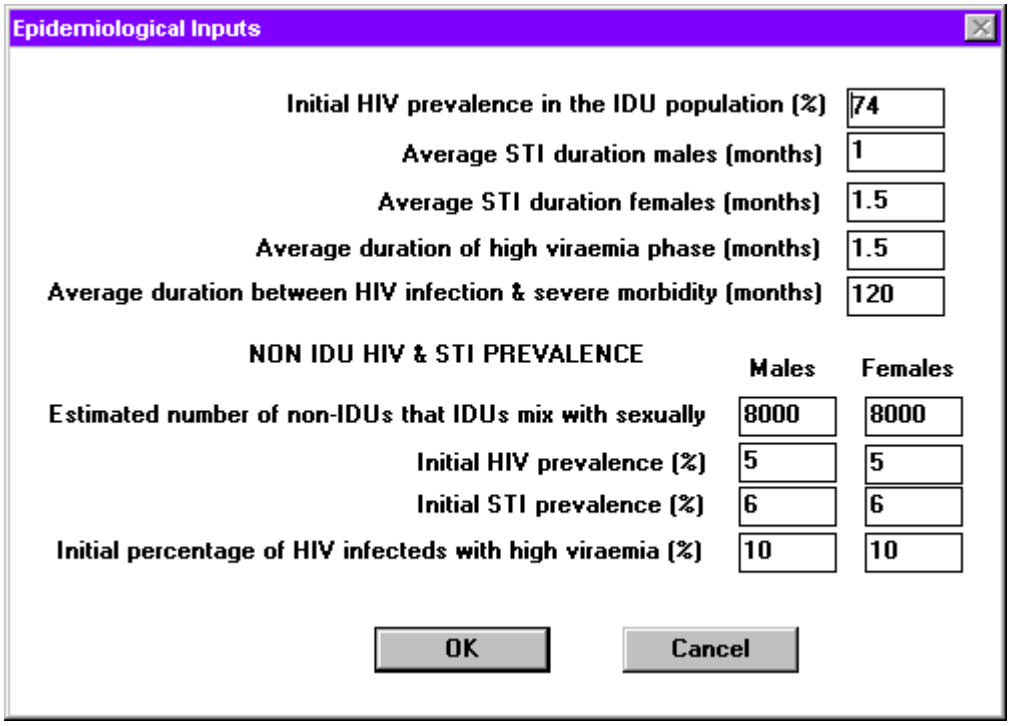


- Timescale over which calculations run (months) – this is used to define how long to run the calculations. We do not recommend using timescales greater than five years (60 months).

- Step size (months) – this is used to define the time period used for each iterative calculation of the distribution of HIV and STD infection (see Appendix 2 for further details). In general, the smaller the step size used the better, and computational difficulties may arise if the step size used is too large. However, the use of too small a step size will result in the computations being slow. To identify an appropriate step size to use, run the model with the default step size. Halve the step size, and run the model again. If the results do not differ substantially, you may continue with the larger step size. If the

results are fairly different, you will need to again reduce the step size, and assess whether the results differ again. In this way, through trial and error, the most appropriate step size for any set of input parameters can be determined. The rationale behind this is described in more detail in Appendix 2.

4.2 **Epidemiological Inputs** - change epidemiological inputs



- Initial HIV prevalence in the IDU population (%) – Prevalence of HIV among IDUs at the start of the intervention.

- Average STI duration males (months) - The average duration of STIs among males. The duration chosen should broadly reflect the accessibility and quality of STI treatment services available to men.

- Average STI duration females (months) - The average duration of STIs among females. The duration chosen should broadly reflect the accessibility and quality of STI treatment services available to women.

- Average duration of high viraemia phase (months) - Average duration of the observed initial high viraemia phase of HIV infection. At present, it is not thought that this duration varies substantially between settings.

- Average duration between HIV infection and severe morbidity (months) – Average time

between acquiring HIV infection and ceasing injecting and sexual activity due to HIV related morbidity. This may vary between settings.

NON IDU HIV AND STI PREVALENCE

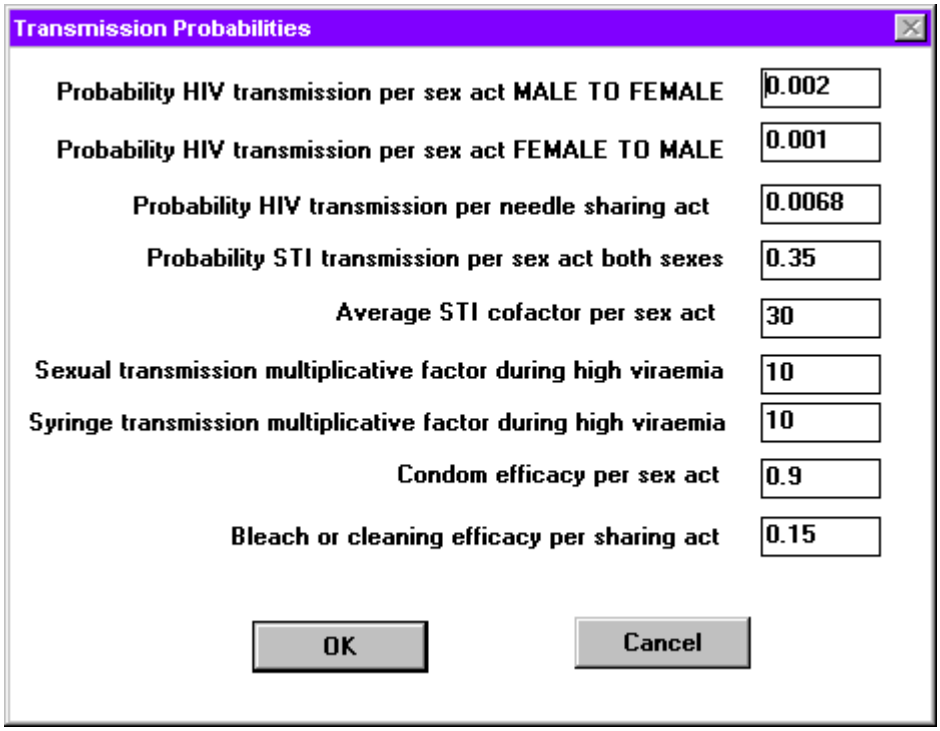
- Estimated number of non-IDUs that IDUs mix with sexually – Estimate of the size of the male and female non-IDU population that female and male IDUs mix with sexually. Given the difficulties associated with estimating this input, it will be necessary to conduct sensitivity analysis using low and high estimates of the population sizes.

- Initial HIV prevalence (%) – Initial HIV prevalence (%) among the male and female non-IDU sexual partners of female and male IDU's. The prevalence figures used should be taken to reflect who may be the non-IDU sexual partners of IDU's. For example, in some settings the female IDU's may sell sex to fund their injecting. In this case, the prevalence figure used should reflect estimates of HIV prevalence among the clients of sex-workers.

- Initial STI prevalence (%) – Initial STI prevalence (%) among the male and female non-IDU sexual partners of female and male IDU's. Again, the prevalence figures used should be taken to reflect who may be the non-IDU sexual partners of IDU's.

- Proportion of HIV infecteds with high viraemia – Estimate of the initial proportion of HIV infected non-IDUs who are in the high viraemia phase.

4.3 Transmission probabilities - change HIV and STI transmission probabilities, the cofactor effect of STI infection, and the initial cofactor effect during the high viraemia of an HIV infection.



- Probability HIV transmission per sex act MALE TO FEMALE - Probability of sexual transmission of HIV infection per sex act from males to females, in the absence of STIs, and/or high viraemia, when a condom is not used. The value used is derived from literature.

- Probability HIV transmission per sex act FEMALE TO MALE - Probability of sexual transmission of HIV infection per sex act from females to males, in the absence of STIs, and/or high viraemia, when a condom is not used. The value used is derived from literature.

- Probability HIV transmission per needle sharing act - Probability of transmission of HIV infection per needle sharing act for both sexes, in the absence of high viraemia, when the needle has not been cleaned. The value used is comes from a US intervention (Kaplan, pers comm).

- Probability STI transmission per sex act both sexes - Probability of transmission of STI infection per sex act for both sexes, when a condom is not used.

- Average STI cofactor per sex act - A multiplicative factor describing the extent to which the probability that HIV is transmitted is enhanced by either partner being infected with an STI per sex act. In

practice, the value used can be taken to reflect the extent to which different forms of ulcerative and non-ulcerative STIs are common. Debate about the likely magnitude of the cofactor for different STIs is ongoing. In general though, a cofactor of 25-40 may be appropriate for settings where ulcerative STIs alone predominate, 15-25 in settings where both ulcerative and non-ulcerative STIs are common, and 5-15 in settings where non-ulcerative STIs predominate.

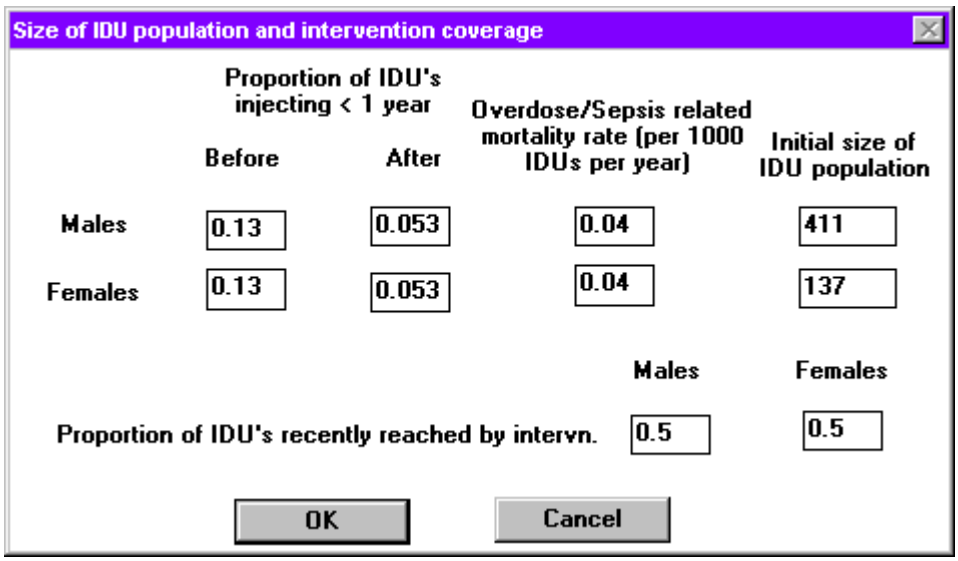
- Sexual transmission multiplicative factor during high viraemia - A multiplicative factor describing the extent to which the per sex act probability of HIV transmission is higher during the initial high viraemia phase of HIV infection.

- Syringe transmission multiplicative factor during high viraemia - A multiplicative factor describing the extent to which the per needle sharing act probability of HIV transmission is higher during the initial high viraemia phase of HIV infection. At present the value used is taken to be the same as the value used for sexual transmission.

- Condom efficacy per sex act - A factor describing the extent to which the use of a condom reduces the per sex act probability of either HIV or STI transmission. The value used may differ between settings, and be chosen to reflect factors such as the quality of the condoms available, the degree to which condoms are used by people when drunk, or the degree to which instructions on condom use are provided. A factor of between 0.9-0.95 may be appropriate for settings where good quality condoms are used well, 0.7-0.9 for setting where good quality condoms are used by people when drunk, and 0.5-0.7 in settings where condoms are of poor quality, or reported levels of condom breakage are high.

- Bleach or cleaning efficacy per sharing act - A factor describing the extent to which cleaning syringes reduces the per needle sharing act probability of either HIV or STI transmission. Debate is ongoing about whether cleaning with bleach or other substances is an effective method of HIV prevention. In addition, efficacy will depend upon the appropriateness of the method of cleaning used (for example, whether equipment is cleaned with water or bleach, the amount of bleach used, and the length of time that bleach is left in the syringe).

4.4 Size of IDU population and intervention coverage - changes behavioural inputs that describe and effect the size of the reached and not reached IDU population.



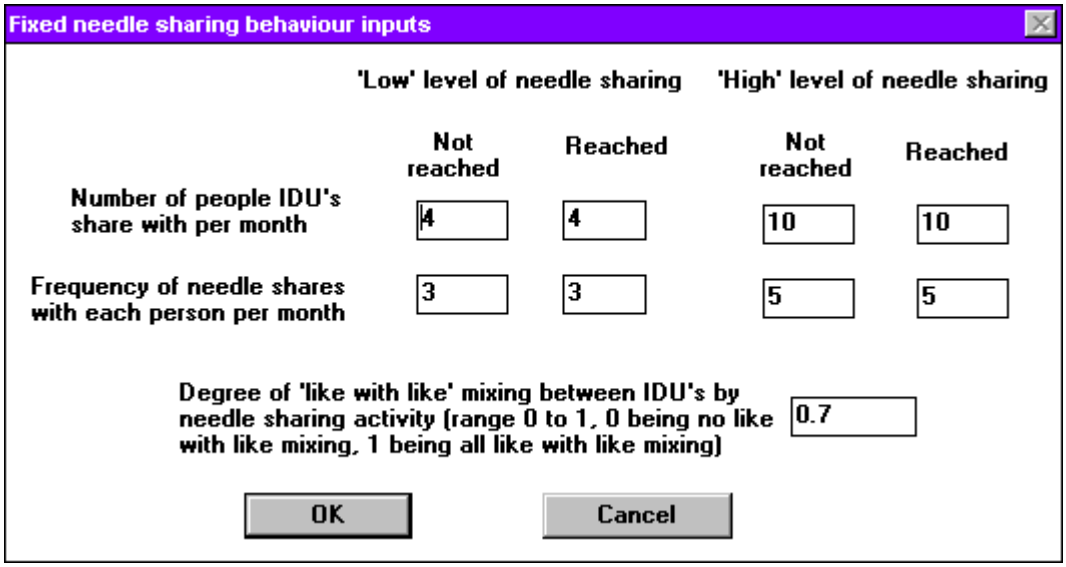
- Proportion of IDU's injecting < 1 year – Proportion of male and female IDU's that have started injecting drugs in the previous year. Inputs describing the distribution before and after intervention are used to estimate the rate of movement of new IDUs into the population, and how this has changed as a result of the intervention. At present, this input is not dependent upon intervention coverage, and represents the average over the total IDU population.

- Overdose/Sepsis related mortality rate (proportion of IDUs per year) – Proportion of IDUs per year that die (such as from drug overdose or sepsis). At present this input is not affected by contact with the intervention.

- Initial size of IDU population – Average number of IDU's in the population being considered.

- Proportion of IDU's recently reached by intervention – proportion of male and female IDU's reached by the intervention. The coverage measure used should reflect a measure of the desired level and form of contact with the IDU population. For example, if an intervention feels that it is important for outreach workers to maintain at least monthly contact with IDUs, to ensure that they have adequate supplies of bleach, needles, syringes and/or condoms, the coverage measure should reflect the proportion of the targeted IDU population having contact with an outreach worker in the last month.

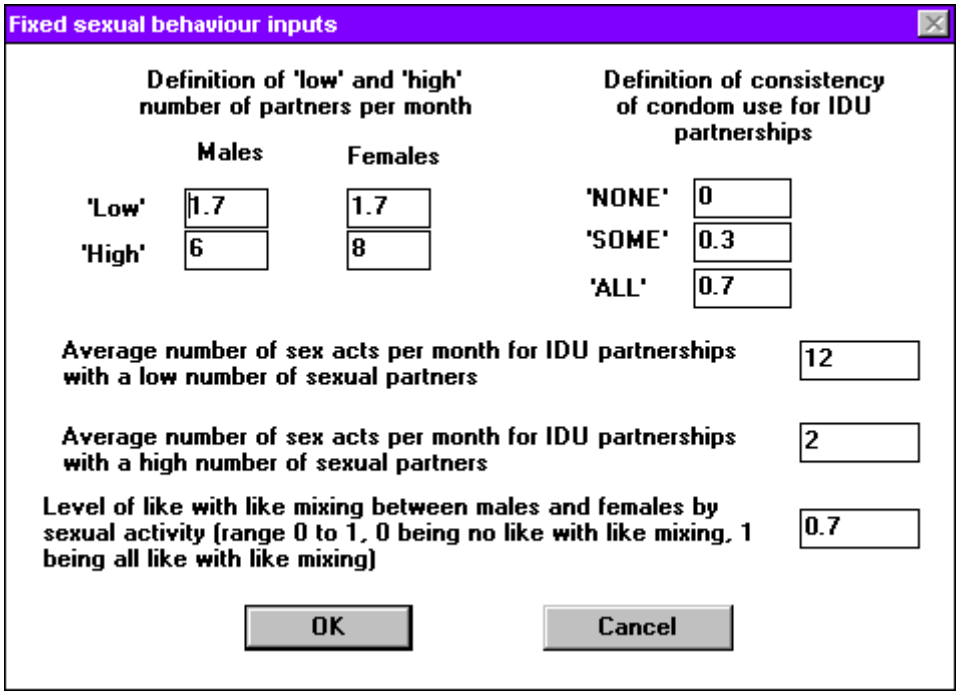
Fixed needle sharing behaviour inputs - change the inputs describing needle-sharing behaviour among IDUs. These inputs are used to describe the range of sharing behaviours among the IDU population being considered.



- In the model IDU's are split into those that do not share needles, those that have a 'low' level of needle sharing, and those that have a 'high' level of needle sharing. In this input screen the sharing patterns of IDU's with 'low' and 'high' levels of needle sharing are defined for those reached and not reached by the intervention. Their sharing patterns are defined using a combination of two inputs: the number of people they share a needle within a month, and the number of needle shares they have with each of these IDU's in a month.

- Degree of like with like mixing between IDU's by needle sharing activity (range 0 to 1, 0 being no like with like mixing, 1 being all like with like mixing). Input parameter that is used reflect the patterns of needle sharing between IDU's with different levels of needle sharing activity, and the extent to which IDUs share with IDUs with similar levels of injecting behaviour. 0 represents no like with like mixing, 1 represents all like with like mixing. This parameter will be difficult to estimate from intervention specific data but may be estimated following discussion with key informants such as IDUs and/or intervention outreach workers. For this reason, sensitivity analysis should be used to explore the implications of the different mixing patterns on the overall patterns of sexual activity.

4.7 Fixed sexual behaviour inputs - change the sexual behaviour data used in the calculations. It is assumed that these inputs do not change as a result of the intervention.



- Definition of low and high number of partners per month – inputs used to describe the distribution in numbers of partners per month among sexually active IDU's. In many settings the range may be quite large and the distribution relatively skewed: with the majority reporting only one partner, but with some reporting many partners.

- Definition of consistency of condom use for IDU partnerships – definition of how to interpret behavioural data on the reported consistency of condom use by male and female IDU's with 'high' numbers of sexual partners*.

  1. 'None' (between 0 and 0.2) - fraction of sex acts in which a condom is used that corresponds to when an IDU reports that a condom has been used 'none of the time' with their partners.

  2. 'Some' (between 0.2 and 0.6) - fraction of sex acts in which a condom is used that corresponds to when an IDU reports that a condom has been used 'some of the time' with their partners.

  3. 'All' (between 0.6 and 1) - fraction of sex acts in which a condom is used that corresponds to when an IDU reports that a condom has been used 'all of the time' with their partners.

- Average number of sex acts per month for IDU partnerships with a 'low' number of

sexual partners – estimate of the number of sex acts per month per partnership among IDUs reporting 'low' numbers of sexual partners.

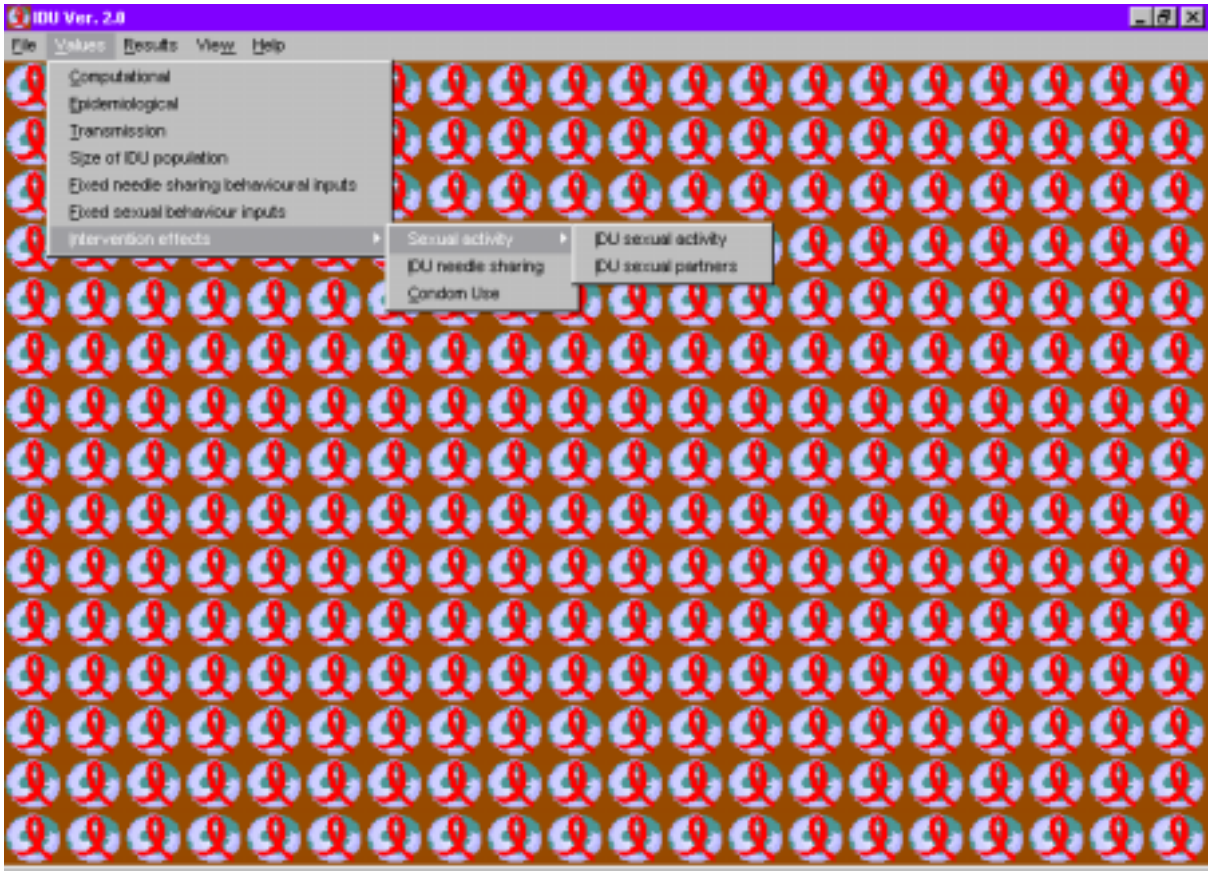
- Average number of sex acts per month for IDU partnerships with a 'high' number of sexual partners – estimate of the number of sex acts per month per partnership among IDUs reporting 'high' numbers of sexual partners.

- Level of like with like mixing between males and females by sexual activity (ranging from 0 to 1). Input parameter incorporated to reflect the patterns of sexual relationship between males and females with different levels of sexual activity, and the extent to which sexually active IDUs tend to have sex with people with similar numbers of sexual partners as themselves (termed like with like mixing). Here 0 represents no like with like mixing, 1 represents all like with like mixing. This parameter will be difficult to estimate from intervention specific data, but can be estimated following discussion with key-informants. For this reason, sensitivity analysis should be used to explore the implications of the different mixing patterns on the overall patterns of HIV transmission.

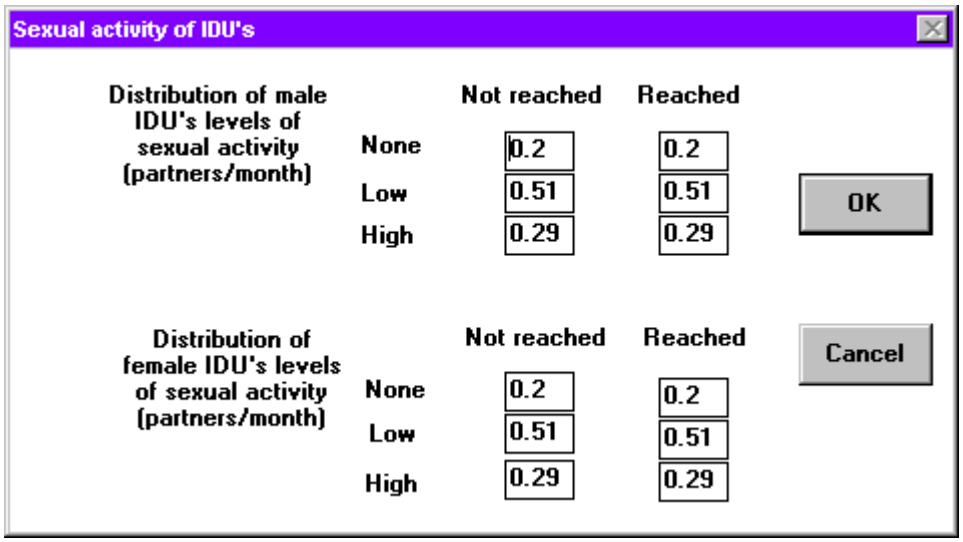
* For simplicity, inputs describing the average consistency of condom use is used for the other sub-categories.

4.8 Intervention effects

The next five screens have inputs describing the ways in which the intervention may affect HIV transmission. To access the different input options it is necessay to use the mouse to select the arrow to the right of [Intervention effects] within the [VALUES] option, and to select the appropriate input screen. The range of input options are shown below.



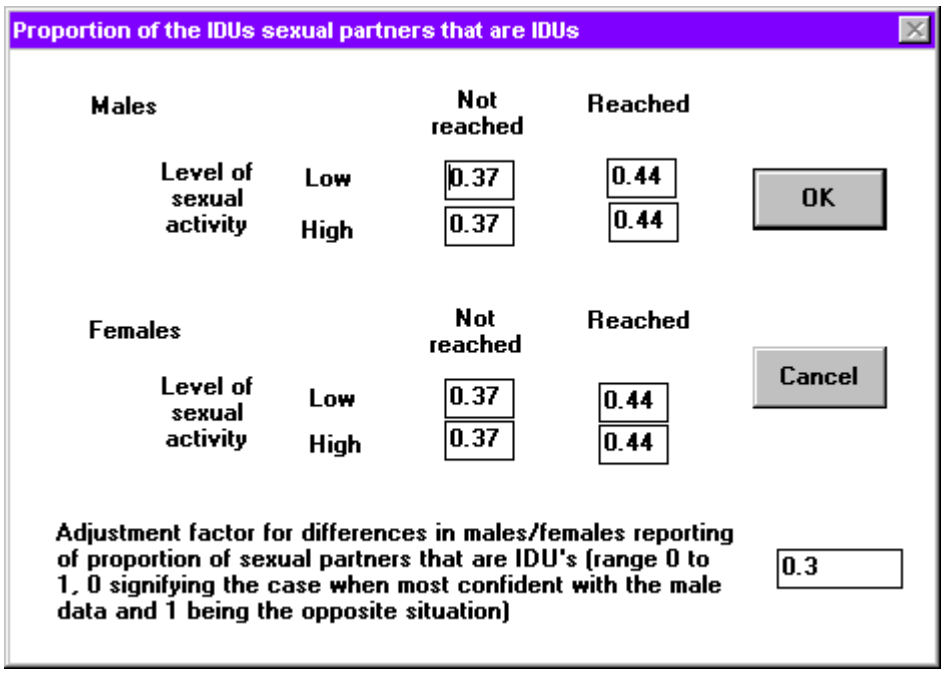
Sexual activity of IDU's



- Distribution of male IDU's levels of sexual activity (partners/month): Proportion of males reached and not reached by the intervention reporting different numbers of sex partners per month (none, low and high numbers of partners per month). The information about males not reached by the intervention can be estimated using either pre-intervention baseline behavioural data, or data from IDU males that have not had contact with the intervention. Note that the three inputs have to add up to 1.

- Distribution of female IDU's levels of sexual activity (partners/month): Proportion of females reached and not reached by the intervention reporting different levels of sexual activity (none, low and high numbers of partners per month). Similarly, the information about females not reached by the intervention can be estimated using pre-intervention baseline behavioural data, or behavioural data from females that have not had access to the intervention. Note that the thee input have to add up to 1.

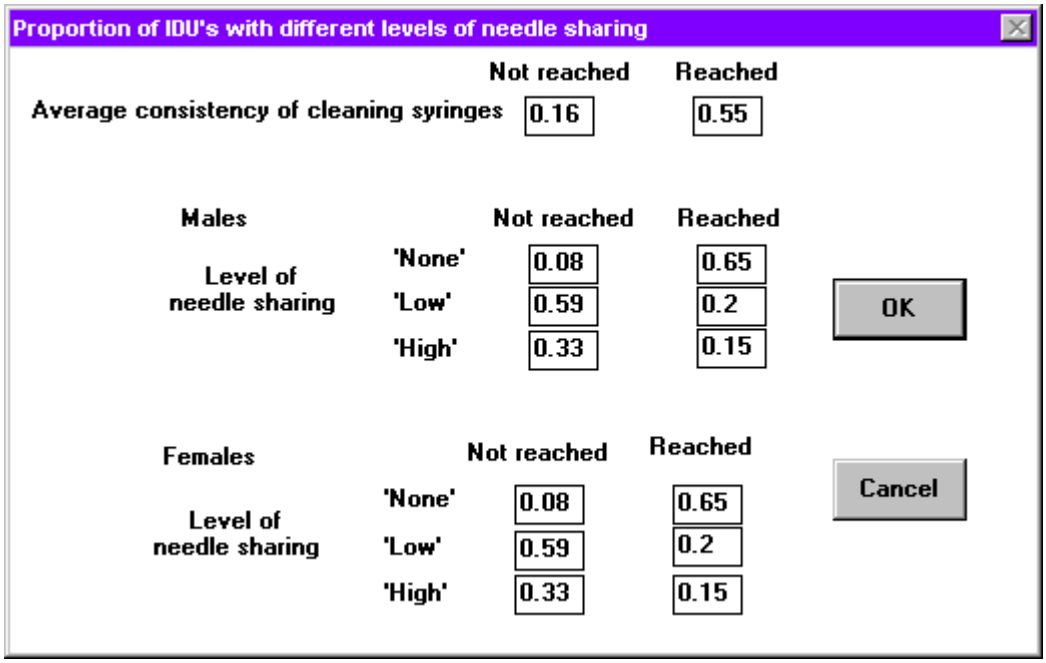
Proportion of IDUs sexual partners that are IDUs



- The proportion of the IDUs sexual partners that are IDU's - Proportion of the sexual partnerships of male or female IDU's that are with IDU's, for reached and not reached IDU's, and for IDU's with low and high numbers of sexual partners.

- Adjustment factor for differences in males/females reporting of proportion of sexual partners that are IDU's (ranging from 0 to 1). Adjustment factor incorporated to reflect that there may be significant differences in the proportion of sexual partners that are IDU's than is reported by male and female IDU's. 0 signifies when the data from male IDU's will be used, and 1 signifies when data from female IDU's will be used. Measures in-between 0 and 1 reflect the relative confidence in the sexual behaviour reported by male and female IDU's.

Proportion of IDUS with different levels of needle sharing



- Average consistency of cleaning syringes – average consistency of cleaning needles, syringes among those reached and not reached by the intervention.
- Level of needle sharing - Proportion of males / females reporting different levels of needle sharing (reached, not reached):

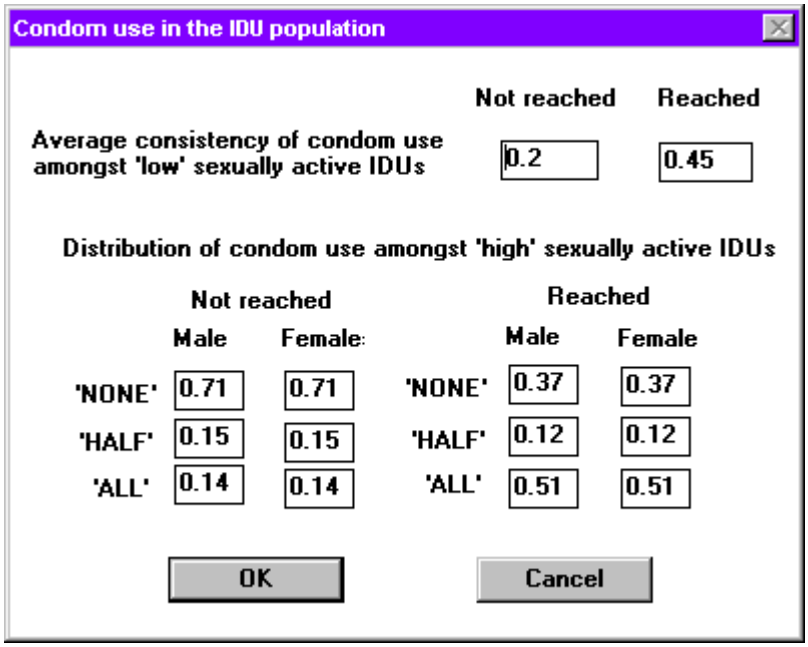
  a) None - Proportion of the IDU's reporting not sharing syringes (as defined in previous screens).

  b) Low - Proportion of IDU's reporting a 'low' level of needle sharing (as defined in previous screens).

  c) High - Proportion of IDU's reporting a 'high' level of needle sharing.

In each case, the 'not reached' figure may come from baseline behavioural information collected at the start of the intervention, or from IDU's who have not had contact with the intervention. The 'reached' figure should come from behavioural evaluation data collected from IDU's who have had recent contact with the intervention.

Condom use in the IDU population



- Average consistency of condom use amongst low sexually active IDU's - among those reached and not reached by the intervention.
- Distribution of condom use amongst 'high' sexually active IDU's - Proportion of male/female IDU's with a high number of sexual partners reporting using condoms with different levels of consistency (reached, not reached):

  a) None - Proportion of IDUs with a high number of sexual partners reporting not using condoms (None defined earlier)

  b) Half - Proportion of IDUs with a high number of sexual partners reporting using condoms half of the time ('Half' defined earlier)

  c) All - Proportion of IDUs with a high number of sexual partners reporting using condoms all of the time ('All' defined earlier)

  Note that for each column, the data inputs (for none, half and all) need to add to one.

  In each case, the 'not reached' figure may come from baseline behavioural information collected at the start of the intervention, or from IDUs who have not had contact with the intervention. The 'reached' figure should come from behavioural evaluation data collected from IDUs who have had recent contact with the intervention.

5. Model outputs

The output of the model is produced when the [CALCULATE] option is chosen from the [RESULTS] menu. The output of *IDU 2.0* can be viewed in a number of different formats as listed under the [VIEW] menu heading. These are described in turn below (also see *Section 3.4*).

5.1 Data outputs

Shows the main data outputs for each month in a tabular format. The table is shown using a program called '*Cell Viewer*' that is automatically opened once the [DATA OUTPUT] option within the [VIEW] menu is selected. The table has the following headings:

Step	Time since start of intervention (months)
bPrev	Projected HIV prevalence amongst IDU's in the absence of the intervention (S0, S1, S2 represent none, low and high needle sharing, respectively)
Prev	Projected HIV prevalence amongst IDU's in the presence of the intervention (S0, S1, S2 represent none, low and high needle sharing, respectively)
Tot Prev	Projected overall HIV prevalence amongst IDU's in the presence of the intervention
bTot Prev	Projected overall HIV prevalence amongst IDU's in the absence of the intervention
IDU avert	Cumulative HIV infections averted amongst IDU's as a result of the intervention
non-IDU avert	Cumulative HIV infections averted amongst non-IDU's as a result of the intervention

Within *Cell Viewer*, there is one menu heading [FILE]. The options within [FILE] can be used to save the data in a text file, print the data, or exit *Cell Viewer* and return to the main menu. Each of the menu options within [FILE] are described below, and can be selected using the mouse; using the down arrow key to move the highlighted bar down to the option required and pressing [Enter]; or by pressing the [Alt] key and the appropriately lettered key together.

File¦Save as... - Saves data as a text file, with the extension NAME.txt. If requred, the data file can then be imported into a package such as excel, for further analysis.

File¦Print - Prints the data file

File¦About - Gives more information about *CellViewer* - this has not been developed.

File¦Exit - Exits *CellViewer* and the data output screen, returning the user to the main *IDU 2.0* menu.

5.2 Graphs

The model output can be viewed in seven different graphical forms, described below. For each graph, the horizontal axis shows the timescale in months over which the calculations were made. The plots can be used to view a range of temporal trends in HIV prevalence, HIV incidence and STD prevalence.

Each of the graphs is viewed using a program called *PlotView*, which is automatically opened once the [GRAPHS] option within the [VIEW] menu is selected. Within *PlotView*, there are two menu options: [FILE] and [VIEW]. The [FILE] menu can be used to rescale and print the graphs, and to exit *PlotView* and return to the main *IDU 2.0* menu.

Within *PlotView*, the [FILE] menu has the following options:

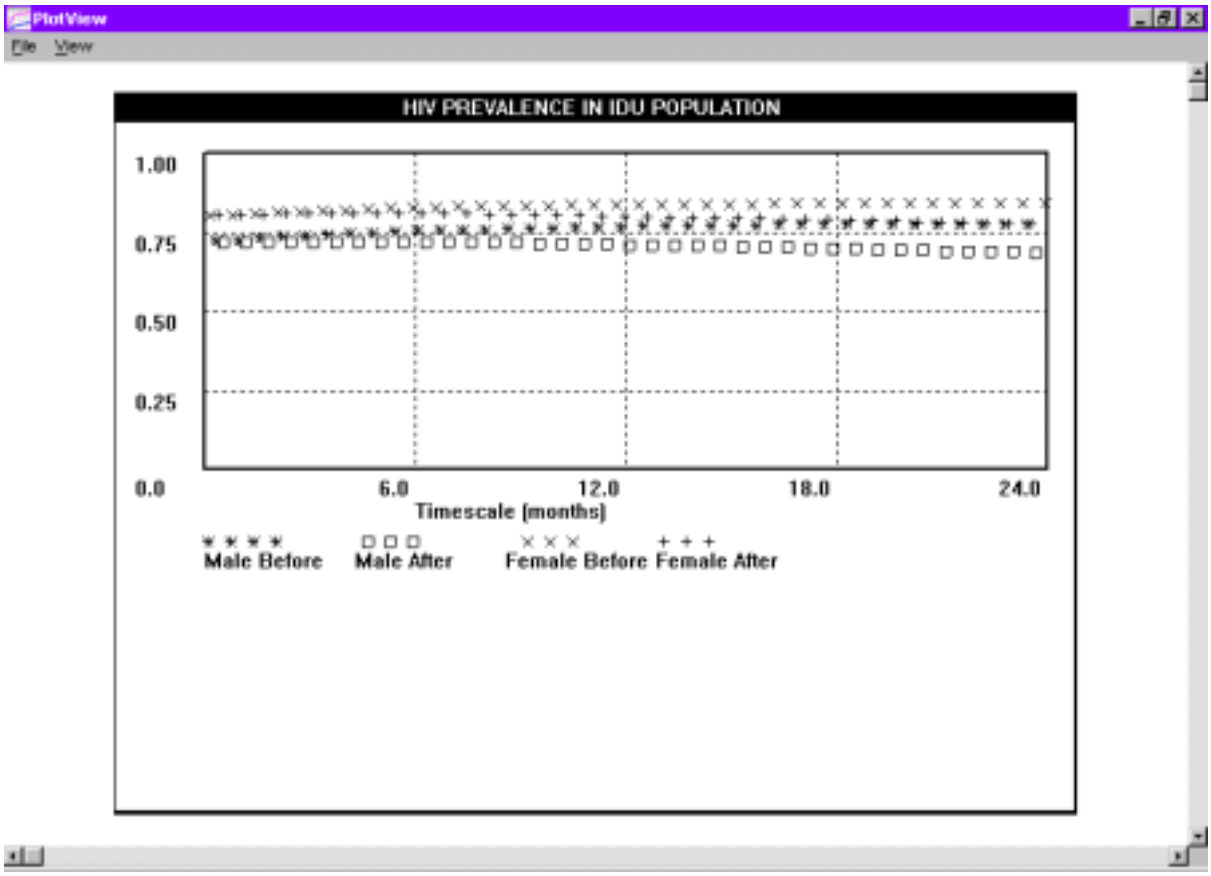
File¦Maximum Y – Enables the user to rescale the plots shown by defining the maximum value for the vertical axis.

File¦Print - Prints the current plot.

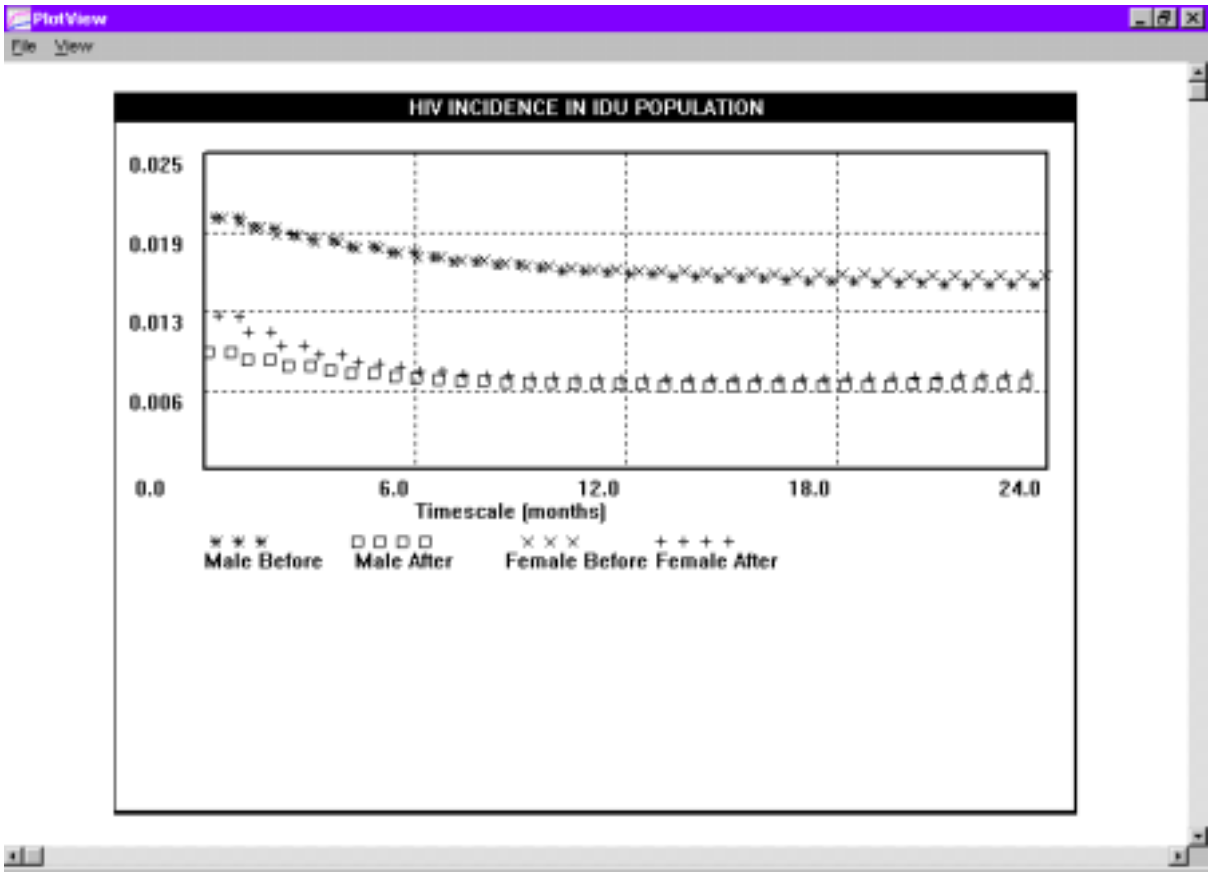
File¦Exit - Exits *PlotView*, returning the user to the main *IDU 2.0* menu.

With *PlotView*, the [VIEW] menu can be used to select one of the pre-assigned plot formats for viewing. These are described in turn below:

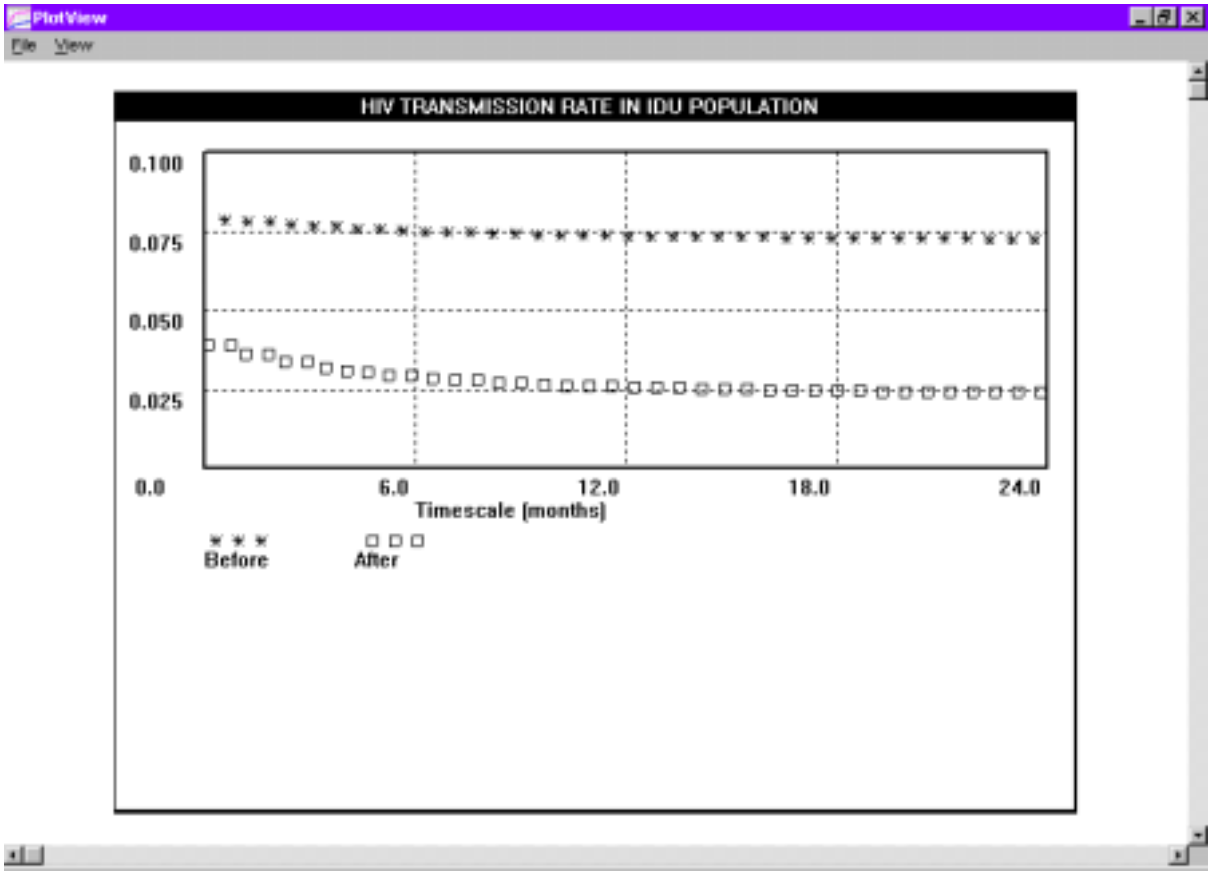
HIV PREVALENCE IN IDU POPULATION - plots a graph of the projected trends in HIV prevalence amongst male and female IDU's with and without the intervention (range 0 to 1). The graph shows the projected proportion of HIV infected male and female IDUs on the vertical axis, both in the presence (After) and absence (Before) of the intervention.



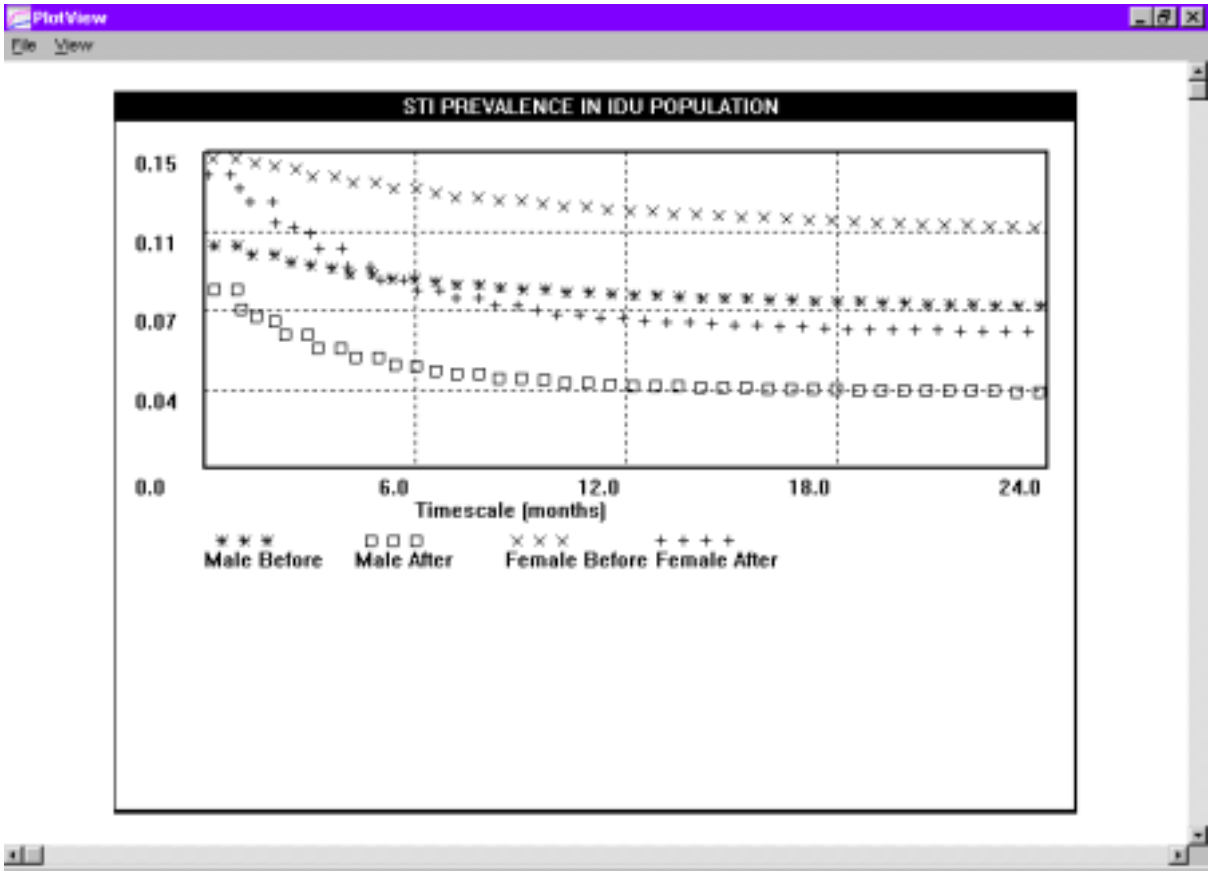
HIV INCIDENCE IN IDU POPULATION – plots a graph of projected trends over time of HIV incidence among IDU's. The graph shows the projected incidence of HIV infection (the ratio of the number of new infections divided by the total size of the IDU population) on the vertical axis for male and female IDU's both in the presence (After) and absence (Before) of the intervention. The vertical axis can be scaled.



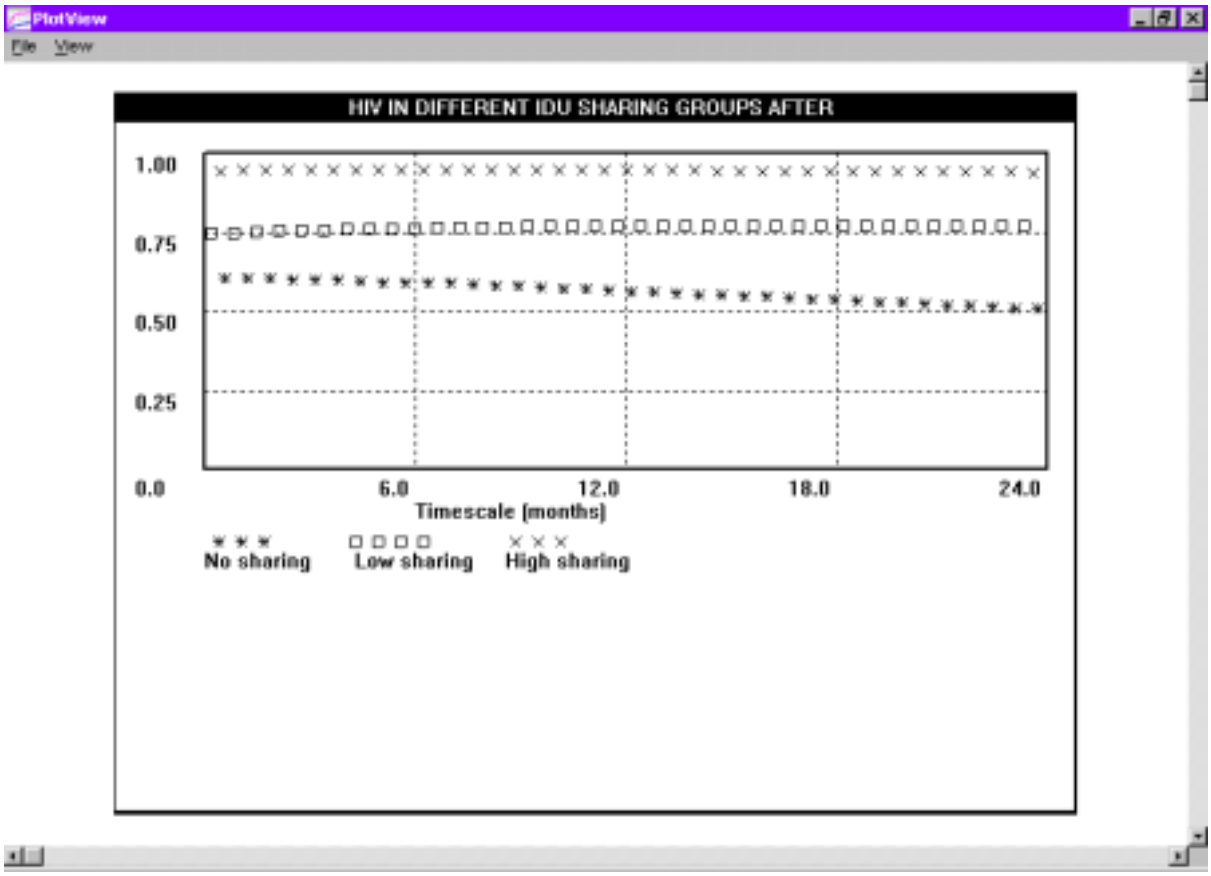
HIV TRANSMISSION RATE IN IDU POPULATION – plots a graph of projected trends over time of the HIV transmission rate (the ratio of the number of new infections divided by the size of the HIV susceptible IDU population). The graph shows the projected transmission rate of HIV infection on the vertical axis for male and female IDU's both in the presence (After) and absence (Before) of the intervention. The vertical axis can be scaled.



STI PREVALENCE IN IDU POPULATION - plots a graph of projected trends over time of STI prevalence among IDU's (range 0 to 1). The graph shows the projected prevalence of STI infection, on the vertical axis, for male and female IDU's both in the presence (After) and absence (Before) of the intervention. The vertical axis can be scaled to an appropriate value.

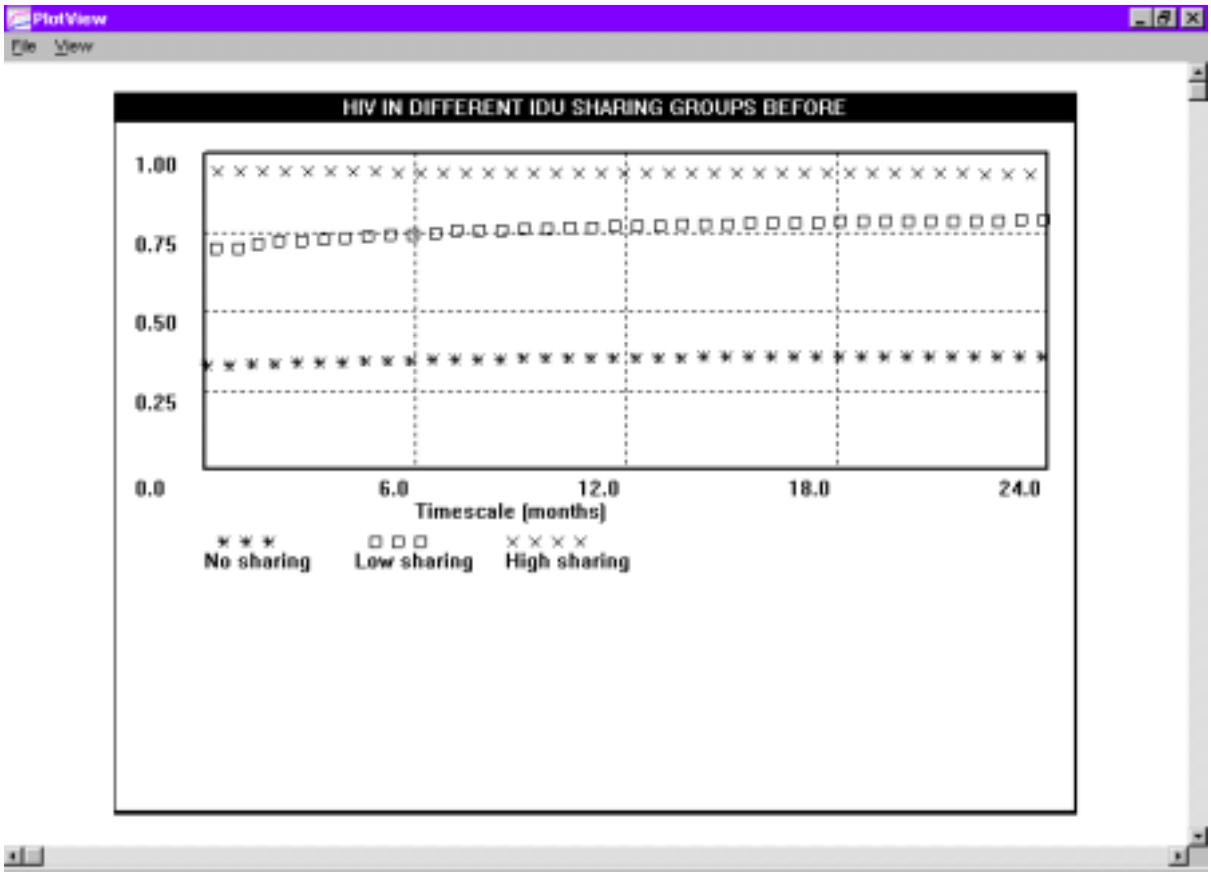


HIV IN DIFFERENT IDU SHARING GROUPS AFTER – The graph shows, on the vertical axis, the projected prevalence of HIV infection among IDU's (range 0 to 1) with different levels of needle sharing, in the presence of the intervention.

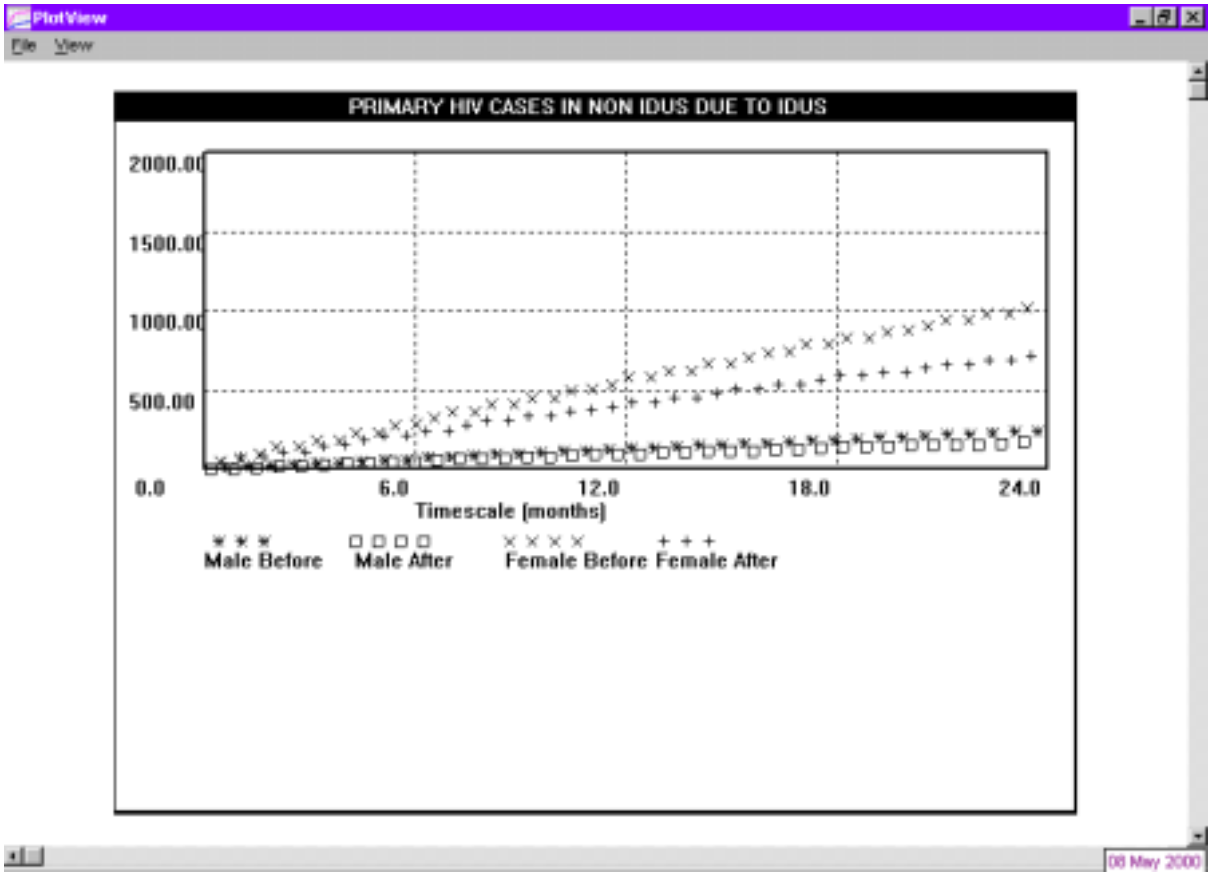


HIV IN DIFFERENT IDU SHARING GROUPS BEFORE – The graph shows, on the vertical axis, the projected prevalence (range 0 to 1) of HIV infection among IDU's with different levels of needle sharing, in the absence of the intervention.

It is important to note that care needs to be taken when interpreting and comparing these trends. For example, comparing the HIV prevalence curves of those not sharing syringes with and without the intervention (the previous figure with this figure), it can be seen that the HIV prevalence among those not sharing is greater in the intervention scenario, than in the non-intervention scenario. In the case presented, the input value for the initial HIV prevalence among IDUs is high (75%). As a result of the intervention, both HIV and non-HIV infected IDUs move from the 'high' and 'low' sharing groups into the 'no sharing groups'. Consequently, this increases the overall HIV prevalence among the 'non-sharing' IDUs, so resulting in the apparently 'negative' impact on HIV prevalence among non-sharing IDUs.

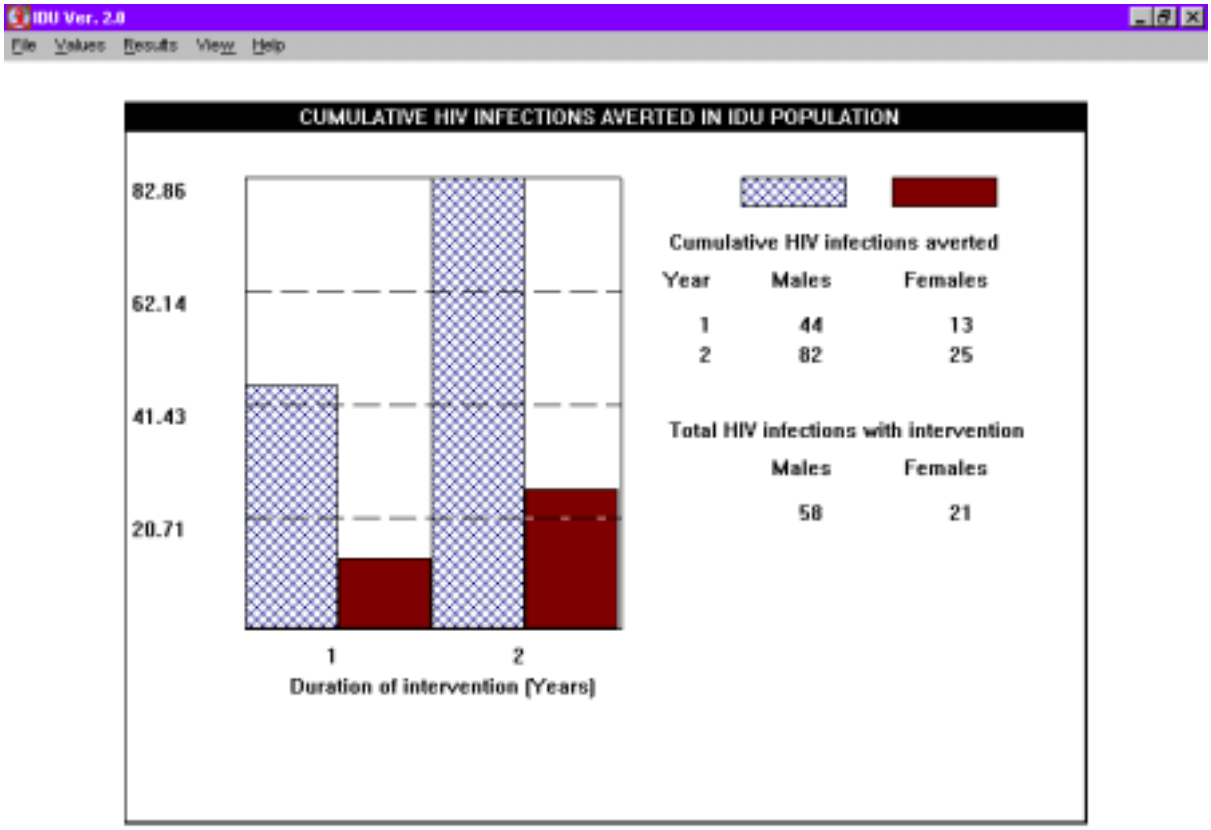


PRIMARY HIV CASES IN NON-IDU'S DUE TO IDU'S - The graph shows, on the vertical axis, the projected cumulative number of primary HIV infection occurring among the non-IDU sexual partners of IDUs, both in the presence (After) and absence (Before) of the intervention.. The infections are resulting from the sexual transmission of HIV from IDU's.



5.3 Infections averted

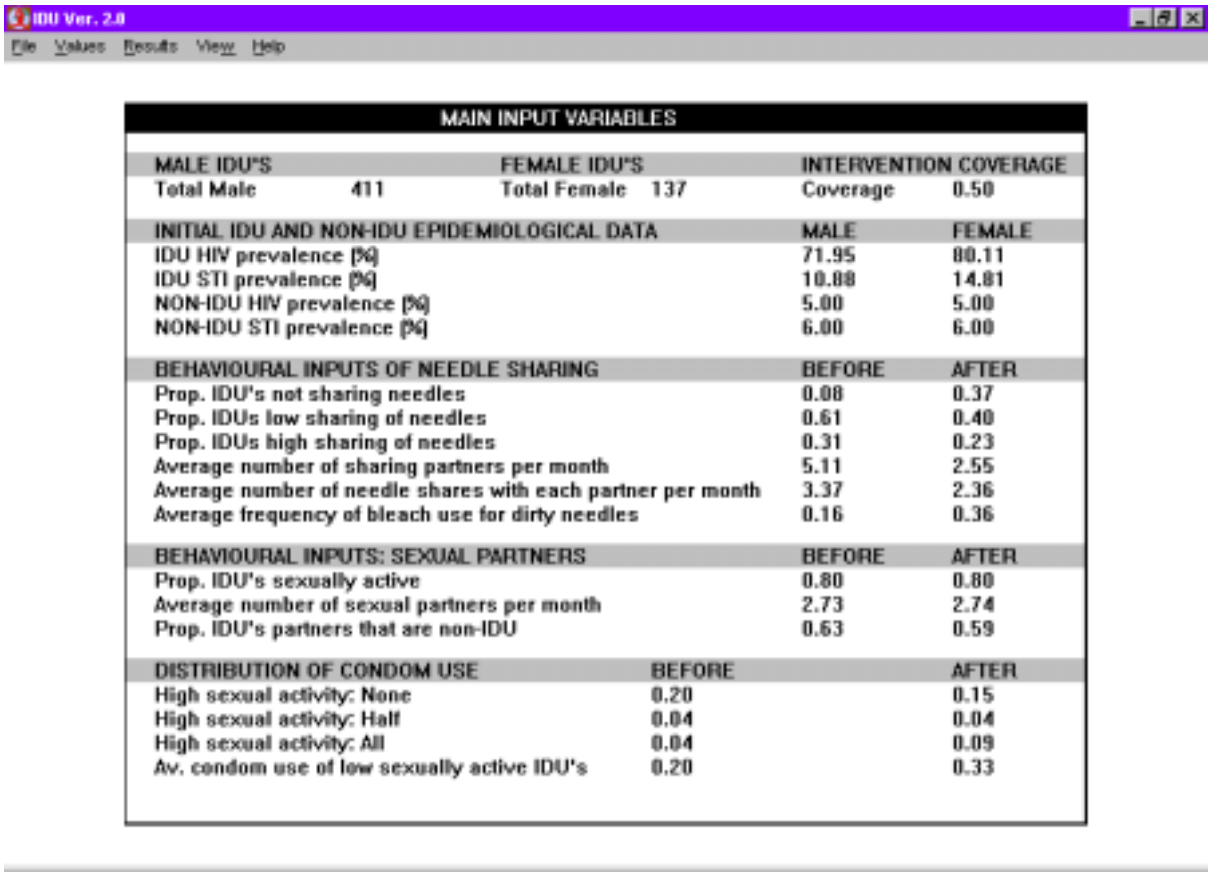
INFECTIONS AVERTED - plots a bar graph of the projected cumulative number of HIV infections averted amongst male and female IDU's as a result of the intervention. The graph shows the estimated cumulative number of HIV infections averted on the vertical axis for males (shaded bars) and females (solid dark bars), for each year of the intervention (horizontal axis). The corresponding figures for each year are shown in the accompanying table. The projected number of HIV infections occurring among male and female IDU's in the presence of the intervention over the timeframe being considered is also given.



5.4 Summary sheets

Two summary sheets have been developed. These outline of the main input variables, and the main output statistics respectively.

MAIN INPUT VARIABLES



The inputs displayed give an overview of the IDU population, the non-IDU population, patterns of sharing and sexual behaviour, and the extent to which IDUs have had recent contact with the intervention.

Total Male IDU's	Input size of overall male IDU population
Total Female IDU's	Input size of overall female IDU population
Coverage	Input describing the proportion of IDUs having recent contact with the intervention

Initial IDU and non-IDU epidemiological data

IDU HIV prevalence	Initial HIV prevalence in the IDU population (%)(male / female)
IDU STI prevalence	Initial STI prevalence in the IDU population (%)(male / female)
NON-IDU HIV prevalence	Initial HIV prevalence in the non-IDU population (%)(male / female)
NON-IDU STI prevalence	Initial STI prevalence in the non-IDU population (%) (male / female)

Behavioural inputs of needle sharing (before and after intervention)

Prop. IDU's not sharing needles	Proportion of IDU's that do not share their syringes or needles
Prop. IDU's low sharing needles	Proportion of IDU's that have 'low' levels of needle sharing
Prop. IDU's high sharing needles	Proportion of IDU's that have 'high' levels of needle sharing
Average number of sharing partners per month	Average number of IDU's with which an IDU shares needles and syringes per month.
Average number of needle shares with each partner per month:	Average number of times that an IDU shares syringes with each of the IDU's they share with in a month.
Average frequency of bleach use for dirty needles:	Average proportion of times that a used syringe and/or needle is cleaned before re-use.

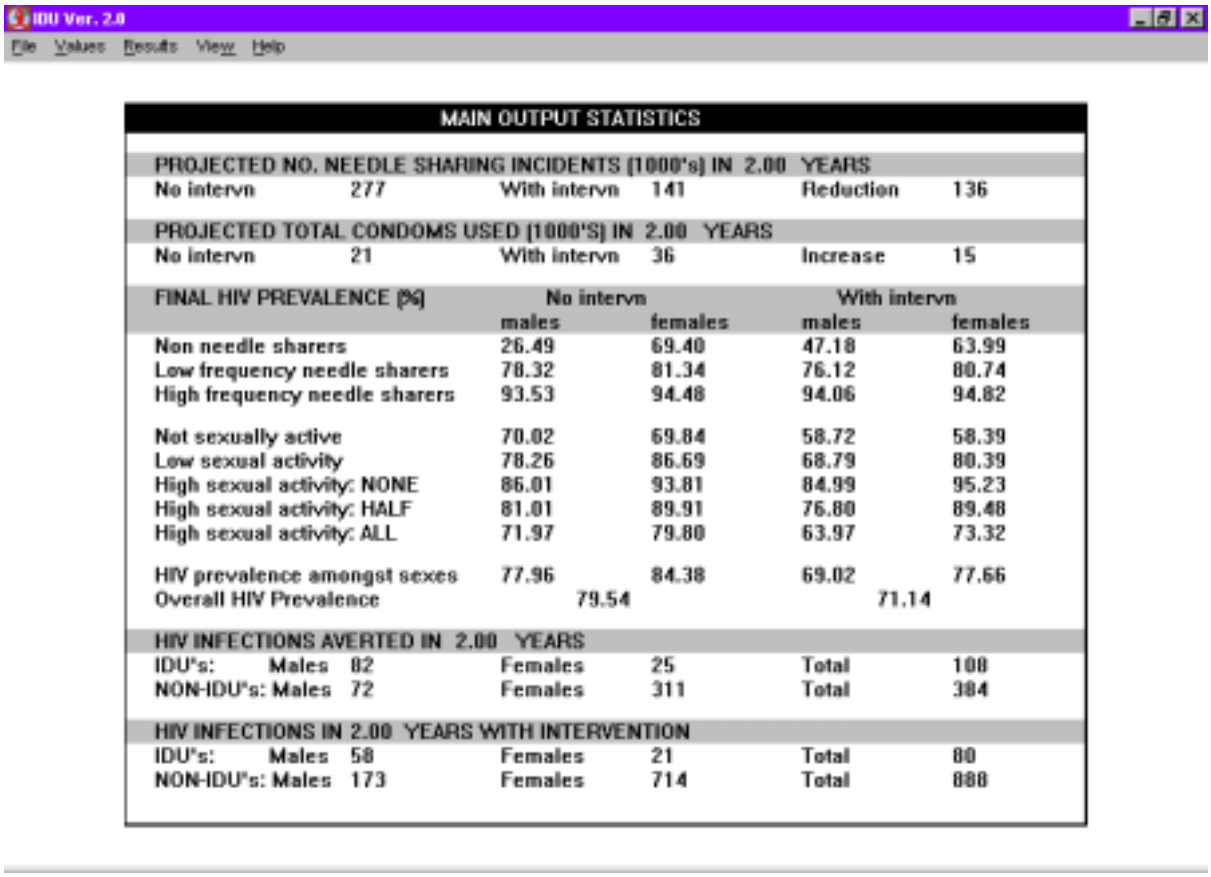
Behavioural inputs: sexual partners

Prop. IDU's sexually active	Proportion of IDU's that are sexually active
Average number of sexual partners per month	Average over the whole IDU population
Prop. IDU's partners that are non-IDU	Proportion of the sexual partners of IDU's that are non-IDU

Distribution of condom use

High sexual activity: None	Proportion of IDU population with high numbers of sexual partners and do not use condoms
High sexual activity: Half	Proportion of IDU population with 'high' numbers of sexual partners and use condoms 'half of the time'
High sexual activity: All	Proportion of IDU population with 'high' numbers of sexual partners and use condoms 'all of the time'
Av. Condom use of low sexually active IDU's	Average condom use of IDU's with 'low' numbers of sexual partners.

MAIN OUTPUT STATISTICS



The outputs displayed give an overview of how the intervention has decreased overall levels of needle sharing and sexual behaviour and increased overall levels of condom use. They also show the predicted effect of these changes on the prevalence of HIV infection among different sub-groups, and the resulting cumulative number of HIV infections averted over the timeframe being considered.

The main headings and outputs are:

Projected no. needle sharing incidents (1000's) in 'timeframe' years

The total projected number of needle sharing incidents amongst IDU's in the timespan considered, with and without the intervention, and the resulting reduction in the number of sharing incidents occuring.

Projected total condoms used (1000's) in 'timeframe' years

The total projected number of condoms used by the IDU's in the last 2 years, with and without the intervention. The difference presented results from both changes in patterns of sexual behaviour, and changes in the extent and consistency of condom use. Note that because of this, if baseline levels of condom use are relatively high, and an intervention results in a substantial decrease in numbers of sexual partners, it is possible that the projected total number of condoms used may decrease.

Final HIV prevalence

In this section, the predicted HIV prevalence at the end of the timespan being considered is presented. Sub-groups considered include among males and females, with and without the intervention, and among different risk groups.

Non-needle sharers	HIV prevalence amongst IDU's that do not share needles
Low frequency needle sharers	HIV prevalence amongst IDU's that have a low frequency of needle sharing
High frequency needle sharers	HIV prevalence amongst IDU's that have a high frequency of needle sharing
Not sexually active	HIV prevalence amongst IDU's that are not sexually active
Low sexual activity	HIV prevalence amongst IDU's with a low number of sexual partners per month
High sexual activity: NONE	HIV prevalence amongst IDU's with a high number of sexual partners per month that do not use condoms
High sexual activity: HALF	HIV prevalence amongst IDU's with a high number of sexual partners per month that use condoms half of the time
High sexual activity: ALL	HIV prevalence amongst IDU's with a high number of sexual partners per month that use condoms all of the time
HIV prevalence amongst sexes	The overall HIV prevalence amongst male and female IDUs
Overall HIV prevalence	The overall HIV prevalence amongst the IDU's before and after the intervention.

HIV infections averted in 'timeframe' years

Estimate of the total number of HIV infections averted among male and female IDU's over the timeframe being considered, and the total number of HIV infections averted among the non-IDU sexual partners of IDUs.

HIV infections in 'timeframe' years with the intervention

Estimate of the total number of HIV infections occuring among male and female IDU's in the presence of the intvervention over the timeframe being considered, and the total number of HIV infections occuring among the non-IDU sexual partners of IDUs.

Appendix 1: Summary of input parameters required by *IDU* 2.0, and default model values

Data input type	Data inputs	Default value M	F
Epidemiological inputs	Initial HIV prevalence in the IDU population	74%	
	Average STI duration for IDU's *	1.0	1.5
	Average duration of high viraemia phase (months)	1.5	
	Average duration between HIV infection and severe HIV morbidity (months)	120	
	Estimated number of non-IDUs that Idus mix with sexually	8000	8000
	Initial HIV prevalence	5%	5%
	Initial STI prevalence	6%	6%
	Proportion of non-IDU sexual partners with high viraemia	10%	10%
Transmission probabilities	Probability of HIV transmission per sex act (male to female) †	0.002	
	Probability of HIV transmission per sex act (female to male)	0.001	
	Probability of HIV transmission per needle sharing act ‡	0.0068	
	Probability of STI transmission per sex act both sexes §	0.35	
	Average STI cofactor per sex act **	30	
	Sexual transmission multiplicative factor to transmission rate during high viraemia phase ††	10	
	Syringe transmission multiplicative factor during high viraemia phase ‡‡	10	
	Condom efficacy per sex act	0.9	
	Bleach or cleaning efficacy per sharing act	0.15	

* STI duration is dependent on local health services situation
† HIV transmission rate for male to female, see refs. European study group 1992
‡ Probability of HIV transmission per needle sharing act, see ref. Kaplan & Heimer 1992
§ STI transmission rate, see refs. Hook & Marra 1992, Hethcote & York 1984, Over & Piot 1996
** STI cofactor for HIV transmission, see refs. Laga *et al.* 1993, Hayes *et al.* 1995, Cameron *et al.* 1989, Plummer *et al.* 1991
†† High viraemia cofactor for sexual HIV transmission, see refs. Cohen *et al.* 197, Pinkerton & Abramson 1996, Jacquez *et al.* 1994
‡‡ Syringe transmission cofactor, there have been no specific studies yet done on this and so the same value is used as for the sexual high viraemia cofactor

Size of IDU population and intervention coverage	Proportion of male and female IDU's that have been injecting for less than one year before the intervention		0.13	0.13
	Proportion of male and female IDU's that have been injecting for less than one year after the intervention		0.053	0.053
	Annual mortality rate from IDU (eg. sepsis or drug overdose) for males and females		0.04	0.04
	Initial size of IDU population for males and females		411	137
	Proportion of IDU's recently reached by the intervention for males and females		0.7	0.7
Fixed needle sharing behaviour inputs	Definition of 'low' and 'high' number of needle sharing partners for reached IDU's	Low	4	
		High	10	
	Definition of 'low' and 'high' number of needle sharing partners for not reached IDU's	Low	4	
		High	10	
	Definition of 'low' and 'high' frequency of needle shares per needle sharing partner for reached IDU's	Low	3	
		High	5	
	Definition of 'low' and 'high' frequency of needle shares per needle sharing partner for not reached IDU's	Low	3	
		High	5	
	Degree of 'like with like' mixing between IDU's, by level of needle sharing activity		0.7	

Fixed sexual behaviour inputs	Definition of 'low' and 'high' number of sexual partners per month for males and females	Low	1.7	1.7
		High	6.0	8.0
	Definition of 'NONE', 'SOME' and 'ALL' consistency of condom use for IDUs with high numbers of sexual partners	NONE	0.0	
		SOME	0.3	
		ALL	0.7	
	Average number of sex acts per month for IDU partnerships with a low number of sexual partners		12	
	Average number of sex acts per month for IDU partnerships with a high number of sexual partners		2	
	Degree of 'like with like' mixing between male and female IDU's with different levels of sexual activity		0.7	
Sexual activity of IDU's	Distribution of levels of sexual activity (partners per month) of IDUs reached by the intervention.	Low	0.2	0.2
		Med	0.51	0.51
		High	0.29	0.29
	Distribution of levels of sexual activity (partners per month) of IDUs not reached by the intervention.	Low	0.2	0.2
		Med	0.51	0.51
		High	0.29	0.29
Proportion of the IDU's sexual partners that are IDU's	Proportion of reached IDU's sexual partners that are IDU's for low and high sexual activity	Low	0.44	0.44
		High	0.44	0.44
	Proportion of not reached IDU's sexual partners that are IDU's for low and high sexual activity	Low	0.37	0.37
		High	0.37	0.37
	Adjustment factor to account for possible differences in numbers of sexual partners that are IDU's		0.3	
Proportion of IDU's with different levels of needle sharing	Average consistency of cleaning syringes for reached and not reached IDU's	Reached	0.55	
		Not reached	0.16	
	Population distribution of reached IDU's level of needle sharing (needle sharing activity is either none, low or high)	None	0.65	0.65
		Low	0.2	0.2
		High	0.15	0.15
	Population distribution of not reached IDU's levels of needle sharing (needle sharing activity is either none, low or high)	None	0.08	0.08
		Low	0.59	0.59
		High	0.33	0.33

Condom use in the IDU population	Average consistency of condom use amongst 'low' sexually active IDU's	Reached	0.45	
		Not reached	0.2	
	Distribution of condom use amongst 'high' sexually active IDU's (male and female), reached by the intervention.	NONE	0.37	0.37
		HALF	0.12	0.12
		ALL	0.51	0.51
	Distribution of condom use amongst 'high' sexually active IDU's (male and female), not reached by the intervention.	NONE	0.71	0.71
		HALF	0.15	0.15
		ALL	0.14	0.14

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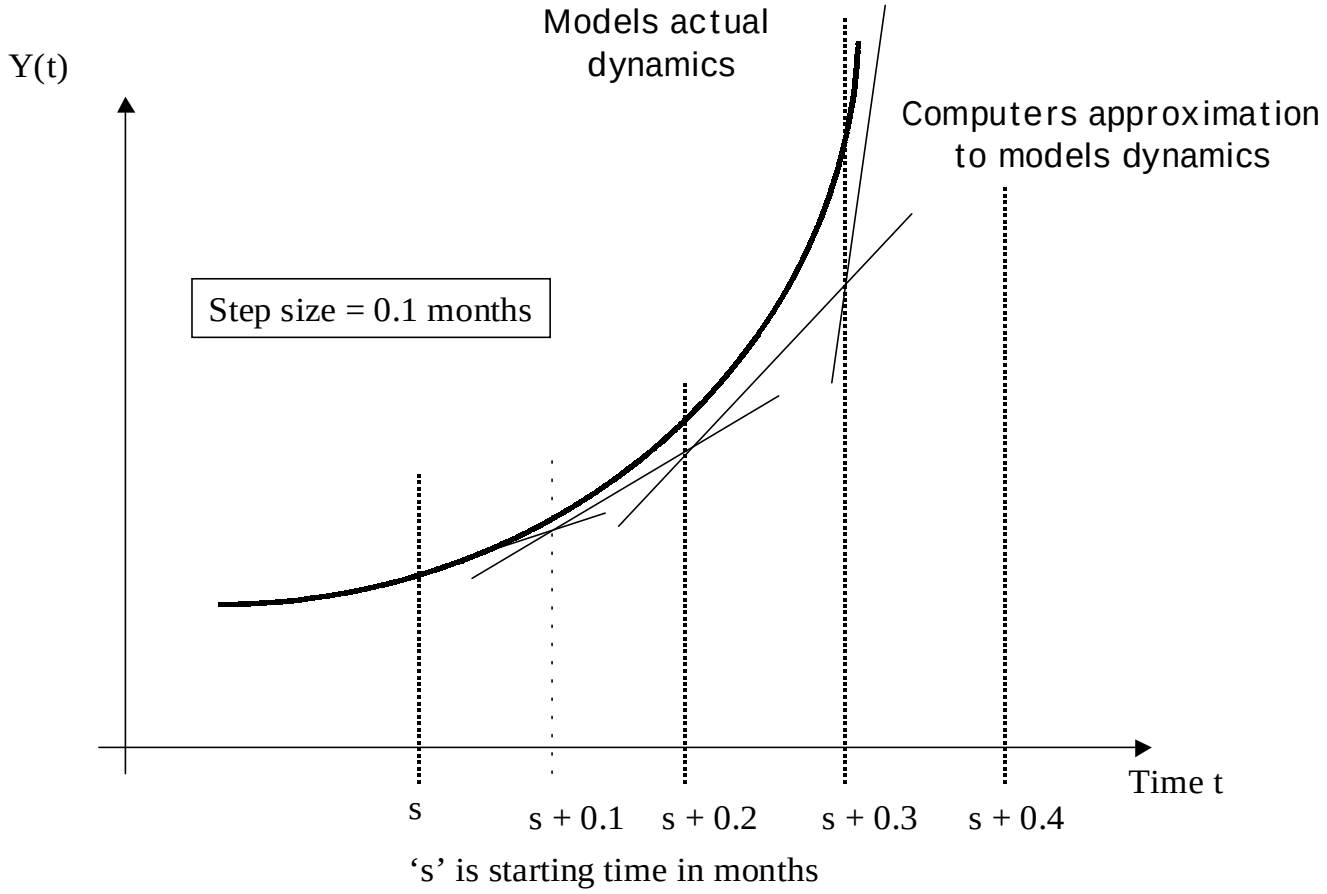
Appendix 2: Effect of step size on the computers numerical approximation to the models dynamics

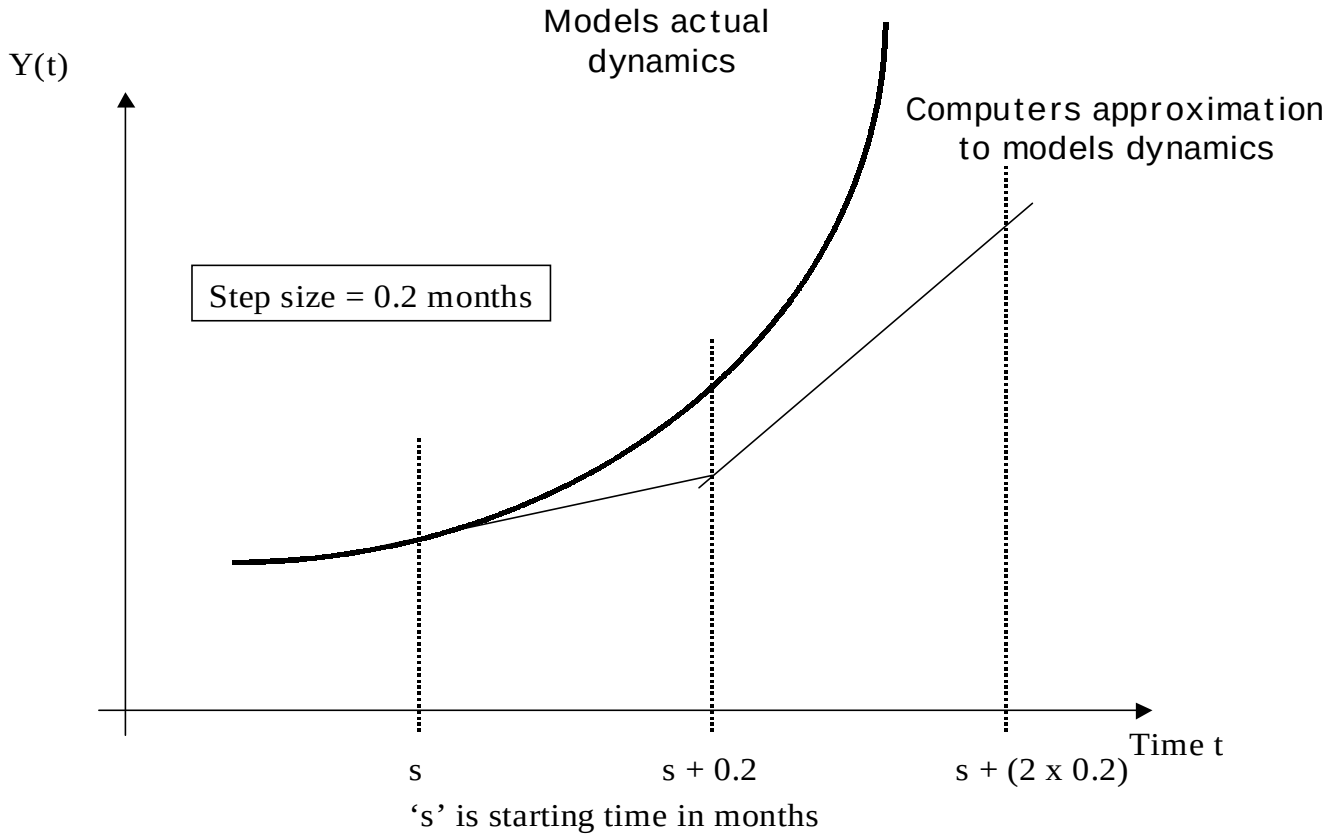
The model simulates the patterns of HIV and STI transmission between the groups targeted by the intervention and their needle sharing and sexual partners. Mathematically, the transmission process is described using methods from calculus. For this, a system of 'deterministic differential equations' are used to describe how, over time, we would expect HIV to be transmitted among the population. This is done by separating out the population being modelled into different sub-groups, according to their patterns of injecting behaviour, sexual behaviour and condom use (described using the behavioural input parameters), and according to their HIV infection status (either susceptible, infected with high viraemia, and infected with low viraemia). For each sub-group, the mathematical equations describe the rate of movement between the different HIV infection sub-groups, as those susceptible to HIV infection become infected, as those with high viraemia move into the low viraemia class, and as those with low viraemia become chronically sick and cease injecting and sexual activity. The rates of movement between these sub-groups are determined by the distribution of STDs at that point in time, and the patterns of injecting and sexual contact between individuals in the different behavioural sub-groups.

These equations describe the slope of the prevalence functions among the different behavioural sub-groups over time. They can be solved to obtain prevalence estimates in each sub-group over time. However, it is not possible to solve these equations algebraically. Instead, numerical methods are used to approximate the solution to them. This is done in a step by step manner (as shown in Figure 1). Starting off with the initial levels of infection (at time s), the slope of each prevalence function is calculated using the differential equations. The prevalence value at the next point in time (say after 0.1 months) is estimated by using the value of the slope to draw a straight line through the initial prevalence value. This is used to approximate the true solution to the differential equation at the next point in time. The accuracy of this method of approximation depends on the size of the step size and the slope of the prevalence function. In general, the smaller the step size, the more accurate the solution. This can be seen by comparing Figures 1 and 2 below – which shows the true solution to the model, and the approximated solutions. In Figure 1 the step size is 0.1. In Figure 2 the step size is 0.2. As can be seen, as the step size is doubled from 0.1 to 0.2 months, the accuracy of the estimated solution greatly decreases.

Therefore, when using the model, it is important to try a range of step sizes, to ensure that the projected values are good approximations to the true solution to the model. The best way of doing this is outlined in the section headed 'step size'.

Figure A1.Estimating the solution to the model dynamics





Appendix 3: *HIVTools* models and publications

1. Currently available from UNAIDS

- *SexWork 3.0*: Models the impact of interventions focused on sex workers and their clients.
- *Blood 3.0:* Models the impact of the strengthening of blood transfusion services.
- *School 2.0:* Models the impact of interventions focusing on youth in school.
- *IDU 2.0:* Models the impact of strategies to reduce HIV transmission among injecting drug users.
- *Costing Guidelines for HIV/AIDS Prevention Strategies*
- *Costing Guidelines for HIV/AIDS Prevention Strategies Among Injecting Drug Using Populations*.

2. Publications

Kumaranayake L, Pepperall J, Goodman H, and Mills A. (1998) *Costing Guidelines for HIV/AIDS Prevention Strategies.* UNAIDS Best Practice Collection - Key Materials. http://www.unaids.org/highbrand/document/economics/index.html.

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Watts CH. (1997) *Microbicides for HIV prevention: imperfect results and public policy*. Background paper for symposium on Practical and Ethical Dilemmas in the Clinical Testing of Microbicides. Women=s Health Advocates on Microbicides/The Population Council, Washington, USA.

Watts C and Kumaranayake L. (1999) Thinking big: scaling-up HIV-1 interventions in sub-Saharan Africa. *The Lancet*. 354: 1492.

Kumaranayake L and Watts C. Moderating discussions on the web: opportunities, challenges and lessons learned. Forthcoming *Health Policy and Planning,* March 2000.

Kumaranayake L and Watts C. *Costs of Scaling HIV Progam Activities to a National Level for Sub Saharan Africa: Methods and Estimates.* Forthcoming Washington, DC: World Bank.

Walker D, Vickerman P, Kumaranayake L et al. (1999) The importance of early intervention for HIV/AIDS prevention: The example of Belarus. Forthcoming *Mir Mediciny* (in Russian).

3. In progress

Watts C and Vickerman P. *SexWork*: new software to estimate the impact of interventions focused on sex workers on their clients.

Kumaranayake L, WattsC, Vickerman P *et al*. Replication and costs of replicating interventions in Cameroon.

Watts C, Vickerman P, Vaughan P *et al*. What matters?: key factors influencing the impact of interventions focused on sex workers and their clients.

Vickerman P and Watts C. *IDU*: a user-friendly model to estimate the impact of HIV interventions among injecting drug users.

Kumaranayake L, Vickerman P, Walker D *et al*. The cost-effectiveness of HIV preventive measures among injecting drug users in Svetlogorsk, Belarus.

Kumaranayake L, WalkerD, Dickun et al. Harm reduction activities among injecting drug users in Belarus: a cost analysis.

Vickerman P and Watts C. HIV education for youth in school: a tool (SCHOOL) to model intervention impact.

Watts C, Kumaranayake L, Vickerman P *et al*. The cost-effectiveness of HIV interventions in sub-Saharan Africa for youth in school.

Kumaranayake L *et al*. The costs of in and out of school HIV interventions in Cameroon.

Watts C, Goodman H, Kumaranayake L *et al*. Factors influencing the cost, impact and cost-effectiveness of initiatives to strengthen blood transfusion services.

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